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Index to Advertisers and Classified Index Following Reading Matter.

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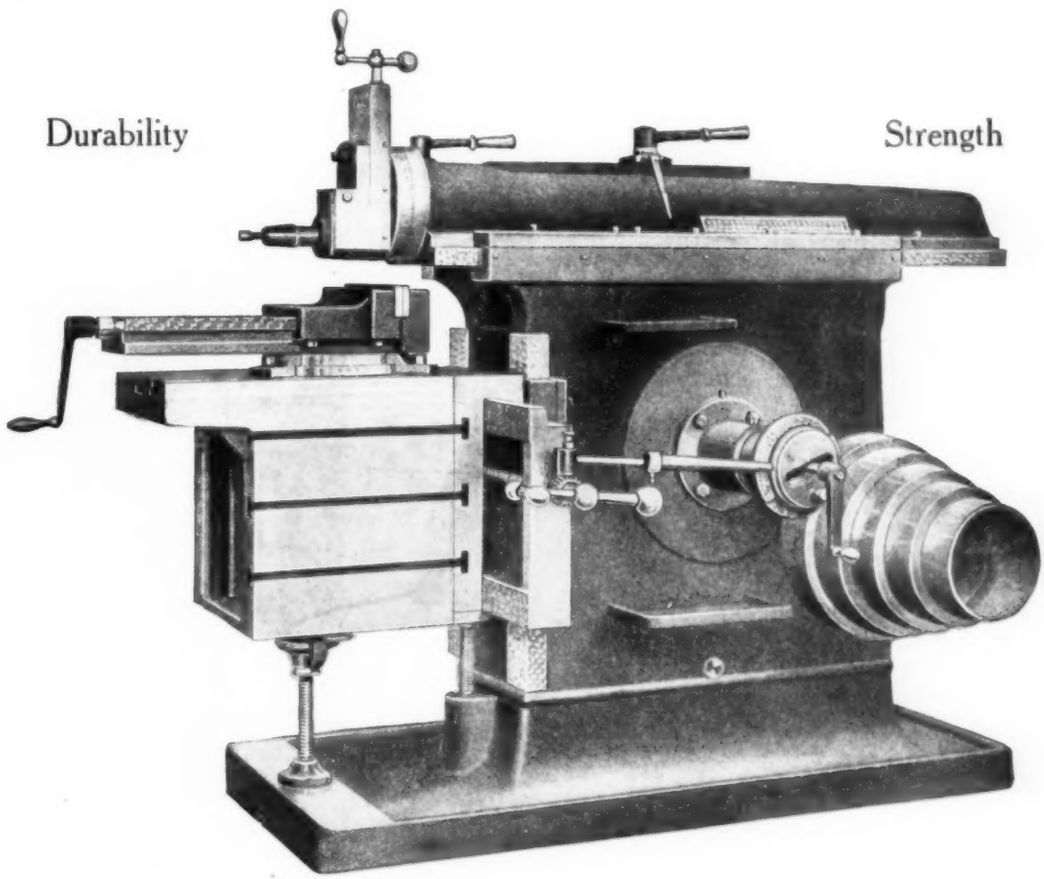

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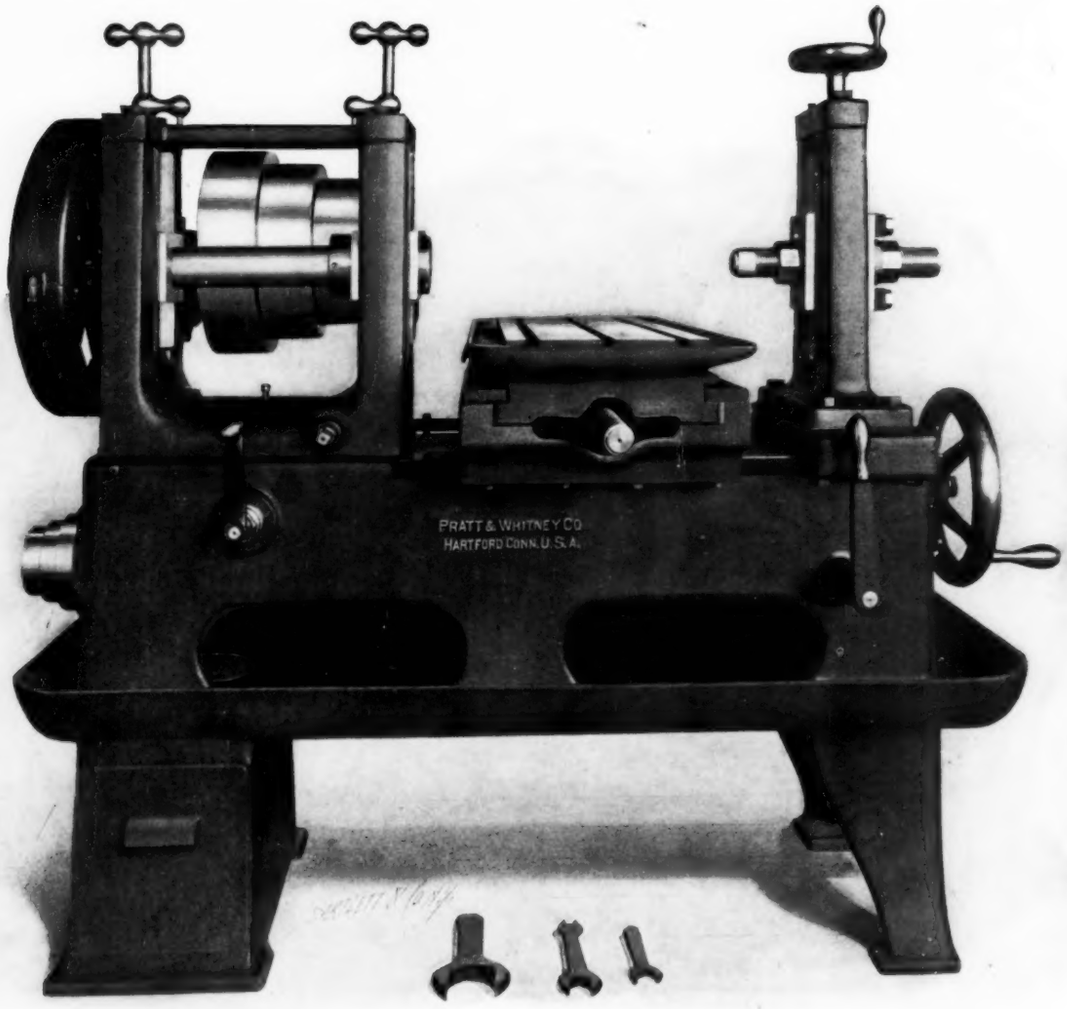

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Some Shop Methods of the American and British Manufacturing Company.

EDITORIAL CORRESPONDENCE.

In the manufacture of ordnance many shapes are required which are unusual, and the result is a series of appliances of a high degree of interest. The above-named company, located at Bridgeport, Conn., makes a specialty of artillery of three inches bore and under, and through their courtesy the accompanying illustrations of some of their methods are given, these methods being due to A. R. Jones, superintendent, and A. S. Baldwin, assistant superintendent of the works.

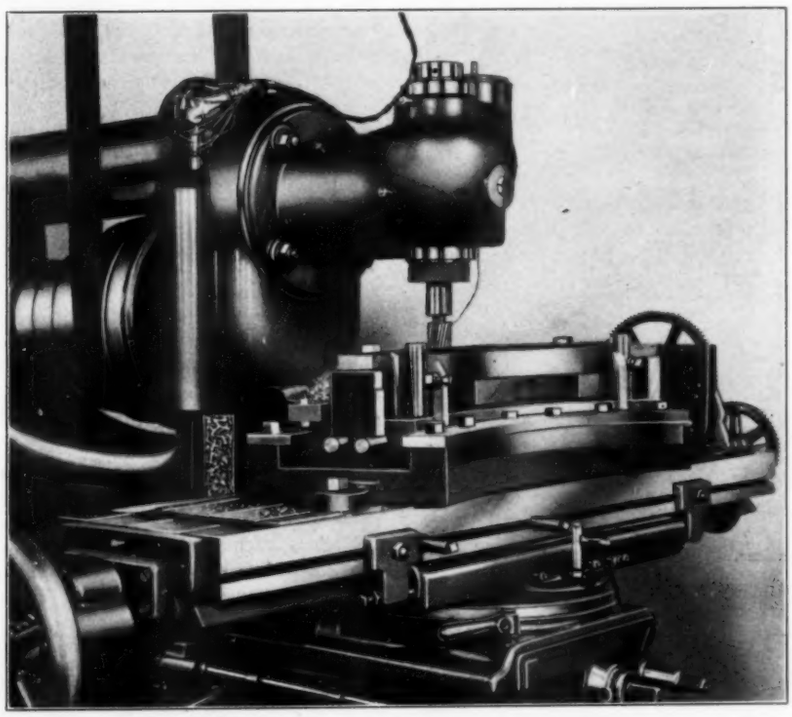


FIG. 1. FRONT VIEW OF RADIUS MILLING ATTACHMENT.

ARC MILLING.

A characteristic piece of gun-sights of this size is an arc-shaped piece called a "sword arm," used for elevating the sight, which is required to be finished on all surfaces and to have a curved rack cut on its inner surface. Figs. 1 and 2 show the milling fixture and Fig. 3 the rack-cutting fixture. In Fig. 1 the fixture is shown as used in combination with a vertical-spindle milling attachment by which most of the work is done. The milling cutter is engaged on the far side of the work, but obviously the same setting is adapted to the front side and to sinking the recess—shown more clearly in Fig. 2—in the top. Fig. 2 shows the fixture used in combination with a horizontal milling cutter for sinking the dove-tailed groove which carries the silver strip on which the graduations are placed. This view shows the feed, which is obtained by a worm and segment of a worm wheel, the worm being driven by gearing at the end of the table. The radius of the arc is, of course, determined by the setting of the work in the jig, and this is done by a removable distance gage placed beween the beveled stops at the ends of the inner surface and shown in Fig. 1. The piece is first roughed out and then located in the fixture by inserting the gage between it and the stops. The gage being then removed, the finishing cut is taken, the stops being far enough removed for the cutter to pass between them and the work. The depth of the inside finishing cut is then gaged by a second gage, the outside cut being determined by measuring across the piece with a micrometer.

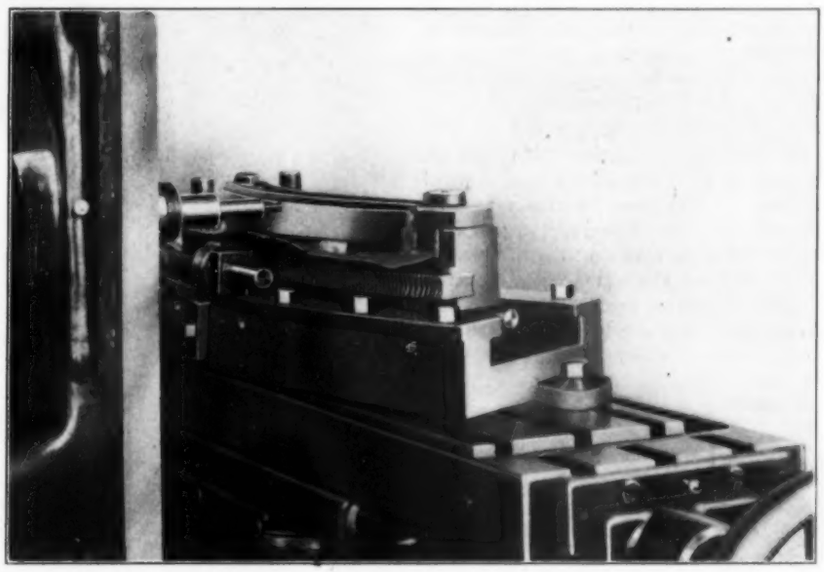


FIG. 2. REAR VIEW OF RADIUS MILLING ATTACHMENT.

Another radius milling attachment is shown in Fig. 3. The work is bolted to a plate, which is swiveled to the table of the milling machine at the right beyond the limit of the illustration, while a screw and pilot-wheel feed accomplish the desired movement.

CURVED RACK CUTTING.

The rack-cutting of the sword arm, Fig. 4, is done without any indexing attachment whatever, the spacing for each tooth being determined from the last one. The first space cut, the work is loosened and slid along until a gage-piece fitting a slot in the fixture will enter it, when the next space is cut, and so on, the finger gage serving also to secure the work to the fixture.

This rack engages with a hand-operated pinion for elevating the sight, and of course no high degree of precision is required in the teeth; but, nevertheless, the error is found to be no more than 1/100 inch in 18 inches.

Fig. 5 shows another segmental milling fixture for cutting curved rack teeth and worm-wheel segments. The fixture which is in place in the machine is for hobbing a worm-wheel segment, the hob being in place on the arbor. A series of index holes will be seen in the curved plate which carries the work, which are used for gashing the work preliminary to hobbing, the index pin being inserted through the hole at the center of the circular recess in the work. The gashing finished, it is only necessary to remove the pin, replace the cutter with hob and proceed with the hobbing. The index holes are drilled by the step-by-step two-hole-guide plan and have a good degree of precision, which is reflected in the work. The diam-

eter of the segment is about five feet, and any other form of fixture would involve a much larger affair.

The curved arm in front of the one shown as being operated on is for cutting the teeth on the concave end of the work.

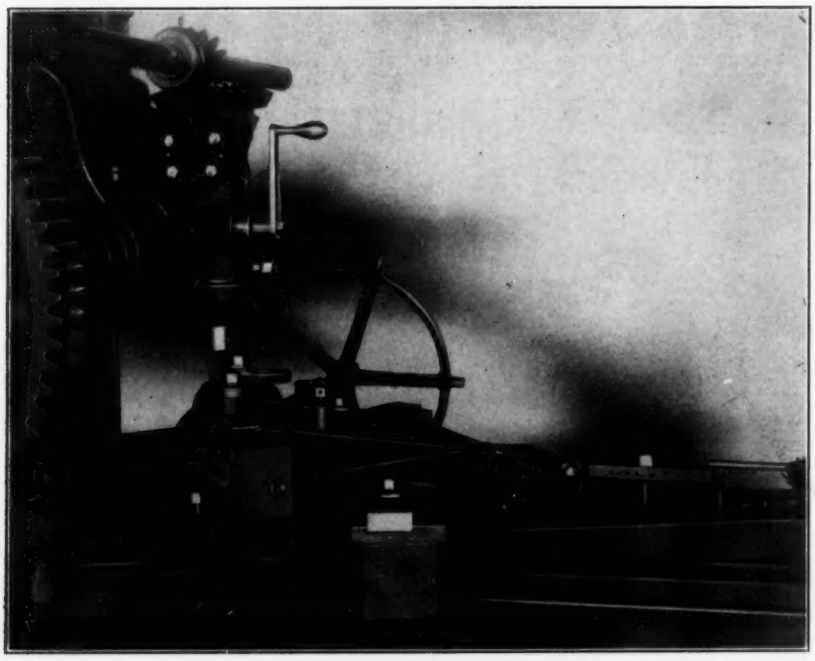


FIG. 3. A LARGE RADIUS MILLING FIXTURE.

The two fixtures are similar, except that the detached guide is concave instead of convex upward. The index pin is shown in place in the second piece of work.

GRADUATING FIXTURE.

Fig. 6 shows another milling-machine attachment for graduating the dial by which the range of the gun is determined. The figures stamped on the dial read in yards of range for a given elevation of the gun, but are of course located on the dial by figures in degrees and minutes, each main division being calculated and indicated, as shown in Fig. 7, which shows part of a drawing of a range dial as supplied by the Government, and from which it will be seen that the graduations are placed on a spiral groove, and that they occupy more than a complete circle. The zero reading mark is on a piece having a tongue which fits in the spiral groove and travels out and in as the dial is turned.

The graduating attachment must be able to read any angle, and while all the divisions in a quadrant of the dial read from the same point, this must be changed to differences between one division and the next in order to do the graduating. For this purpose elaborate tables have been prepared to be used by the operator of the graduating fixture, these tables giving the number of turns and fractions of a turn of the graduated driving disk, of which the back side is shown in Fig. 6.

It will be understood, of course that the divisions of the range dial gradually increase from one end of the arc to the other, and hence it is impossible to use anything corresponding to the index sector of a milling machine universal head. The table must be consulted for each division and the graduated disk must be turned accordingly.

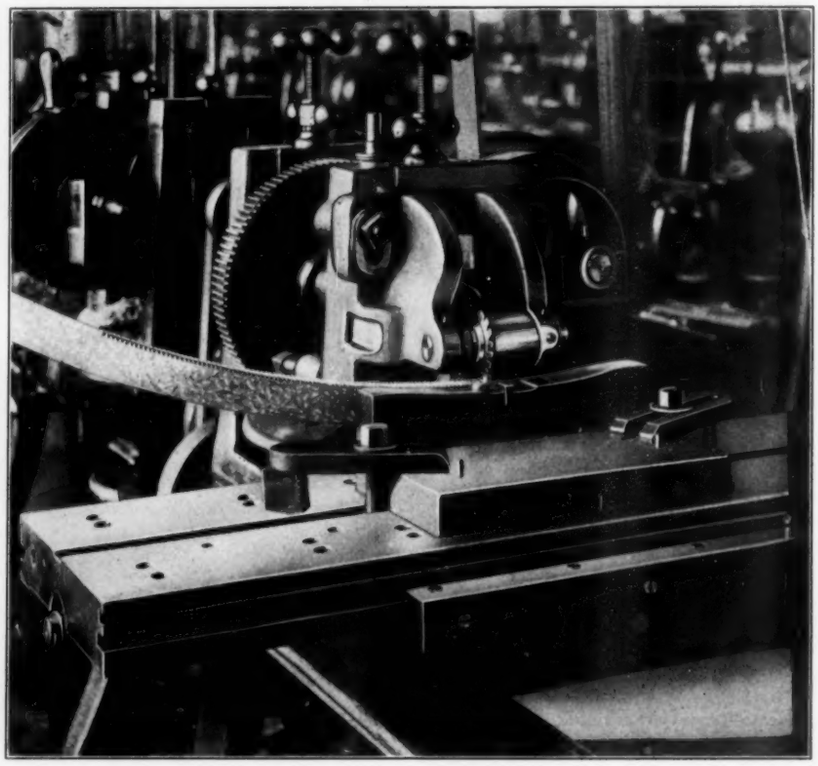


FIG. 4. CURVED RACK-CUTTING FIXTURES.

The work table of the fixture carries a worm wheel having 720 teeth and the disk has 1800 graduations. The worm is single threaded and $720 \times 1800 = 1{,}296{,}000$; and, since there are this number of seconds of arc in a circle, one division of the dial represents one second of the movement of the work. No such degree of precision as this is required or expected in the individual divisions of the work; but without the minute divisions of the dial the locating of each graduation from the preceding one would lead to an accumulation of errors which would be serious. It will be observed that with the proportions of the mechanism two turns of the dial give one degree of movement to the work, the main divisions of the dial representing minutes and the finer ones seconds. The tables referred to above simply tell the workman the number of complete turns and the division to which the dial is to be set for each space in the work.

DRIVING A LATHE BY THE LEAD SCREW.

Fig. 8 shows a method of doing a piece of lathe work that to most readers will be unique. The work in the lathe, of which a duplicate lies on the wing of the lathe carriage, is a part of the breech mechanism. It has a short section of a double internal steep pitch square thread, the angle of which is about 40 degrees. To cut this thread the action is a combination of boring and slotting, and to make the cut the feed of the carriage must be powerful enough to force the tool against the pressure of the cut. The steepness of the thread is such as to require compound gearing with a pinion of only 20 teeth on the lead screw. Mr. Baldwin reasoned that such a small pinion would be unable to do the work if the lathe were driven by the usual driving belt, and he therefore threw that belt off and rigged up the small tapping machine shown in the left foreground which connects with the lead

screw, which thus becomes the first mover of the lathe, and from which the headstock is driven. From this end the gearing reduces, instead of increasing, the speed, and the strain on the lead-screw pinion thus becomes a trifle. The tapping machine gives both forward and backward motions, a clutch on its spindle and two trains of gearing being provided for this purpose.

The rig is semi-automatic only. A rod connected with the clutch extends toward the carriage apron, and when the cut is completed the apron engages the rod, opens the clutch and stops the lathe. The operator then withdraws the tool and pulls the appropriate rope, thus engaging the clutch and reversing the lathe. In the opposite direction the stopping as well as the reversing of the lathe is done by the operator.

THREADING AND SLOTTING THE GUN BREECH.

Figs. 9, 11 and 12 show interesting operations on the breech of the gun. The system of interrupted screw threads, by which the breech block is held in position in the gun, is understood by all. Fig. 9 shows the method of cutting the threads on a lathe, with a special cross slide carrying a milling cutter. The lathe has a special countershaft arrangement for rotating the gun at a very slow speed by means of a worm gear. The feed gear is set up to give the desired pitch, as in any thread-cutting operation. In making the first or roughing cut, the gun rotates once in 10 minutes, but much slower for the finishing cut.

The milling-cutter spindle is driven by a telescopic universal-jointed shaft to permit angular adjustment of the cutter, as well as movement lengthwise and crosswise of the machine. The spindle is carried on a casting with a cylindrical seat and elongated holes for the binding bolts permit adjustment of the angle of the cutter to suit that of the thread to be cut. The cutter may be adjusted up or down to the center line by the angular slide and adjusting screw, of which the nurled head is shown. The thread may be made to start at any point of the circumference of the breech by adjusting the cutter lengthwise of the gun on the horizontal slide above the inclined slide, which also has an adjusting screw, of which the nurled head is shown.

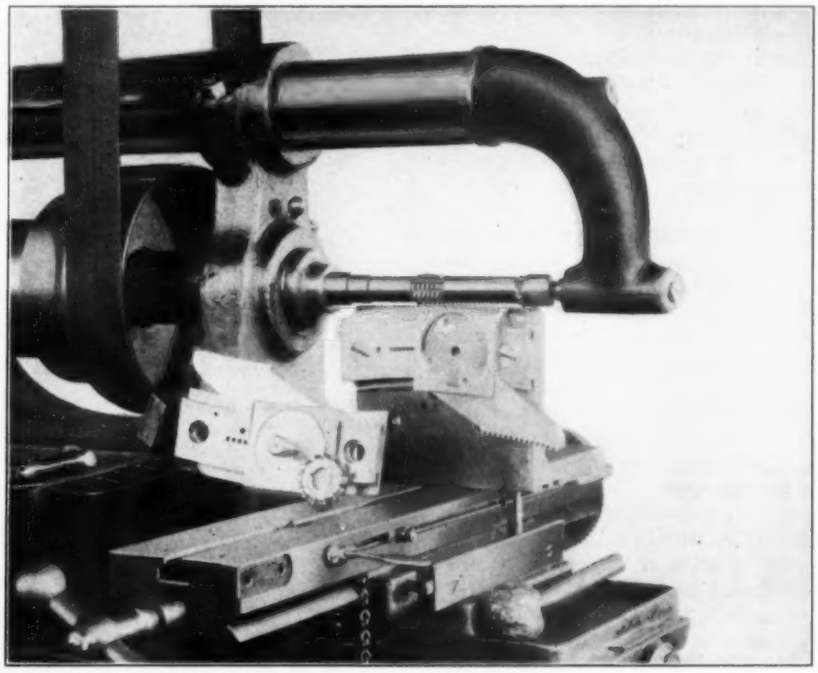


FIG. 5. SEGMENTAL HOBBING FIXTURE.

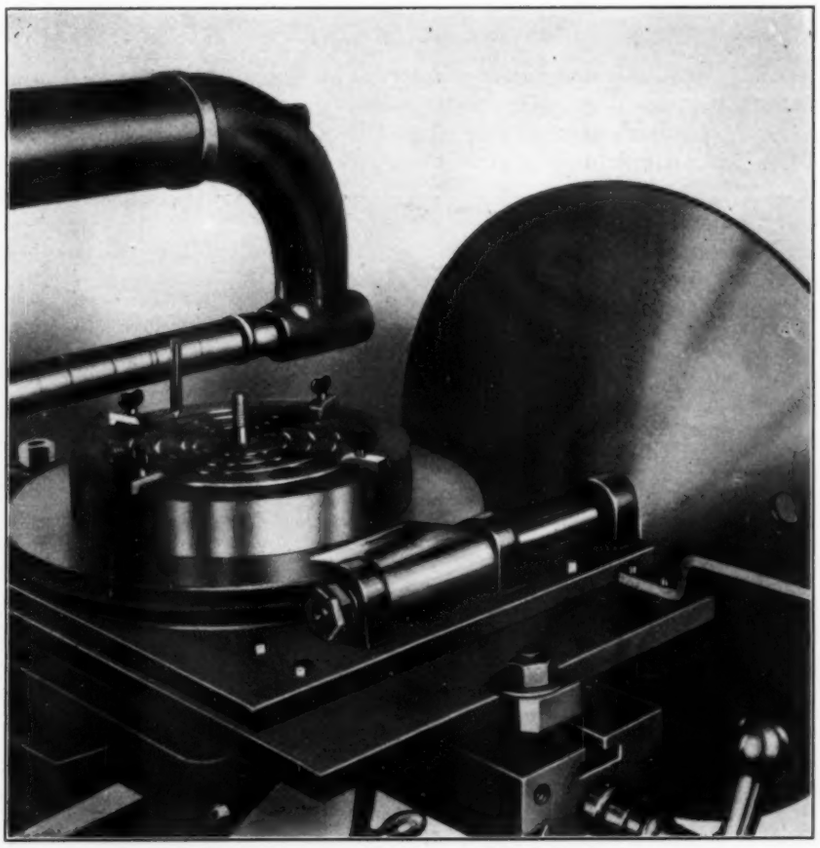


FIG. 6. FIXTURE FOR GRADUATING RANGE DIALS.

The slotting out of the gaps in the threads is done with the outfit shown in Fig. 10. The breech of the gun is shown mounted in the same lathe as that shown in Fig. 9, on the shears on which the slotting fixture is mounted. At the extreme right is seen the bevel driving gear and above it is one end of a connecting rod, by which a crank on the shaft of the bevel gear is made to reciprocate the slotting ram. The tool bar is fed radially for depth of cut by a vertical slide in the end of the ram, the feed of the tool around the gun being obtained by the crank and worm gear, which turn the tool bar within the ram. A short horizontal slide on the end of the ram compensates for the thickness of the tool and enables each end of the cut to be made truly radial with the gun.

Fig. 11 shows a section of the breech of the gun and at *a* will be seen a clearance cut which is necessary in order that the threads on the breech block may clear the threads in the gun when the block is swung into place. The tool for making this cut is shown in Fig. 12. The fixture is driven by the same ram as that shown in Fig. 10, the tool head being swung from the same center as the breech block in the

completed gun. In other respects the action of the fixture will be obvious from the illustration.

AN ECCENTRIC SPIRAL GEAR.

Fig. 13 shows another interesting nicety connected with the breech-block mechanism. The block, the latch handle by which it is operated and the connecting spiral segments are shown assembled on the table. Close examination will show a slight gap between the upper end of the plug and the supporting plate. This gap is open after the plug has been turned for withdrawal only, being closed when the plug is entered in the gun. This slight endwise movement is obviously experienced by the segmental spiral gear attached to the plug and must be provided for in the shape of the operating segment attached to the lathe handle; for, were the pitch line of this segment to be a circle struck from its center of movement, it would either be in loose engagement with its mate at one end of its movement or it would bind at the other. This condition is met by the milling fixture on which the latch handle is shown mounted at the left of the assembled breech block. The handle will be seen to be mounted on a plate carrying a pin, which passes through the hole in the handle. The portion of the pin which fits the hole in the handle is slightly eccentric with the centers of the pin. When mounted in the milling machine for cutting the teeth, the handle and arc are swung about the centers of the pin, which, being eccentric with the hole in the arm, the teeth are cut on a pitch circle, which is eccentric with their future center of motion, and this eccentricity is so calculated as to compensate for the endwise movement of the engaging segment.

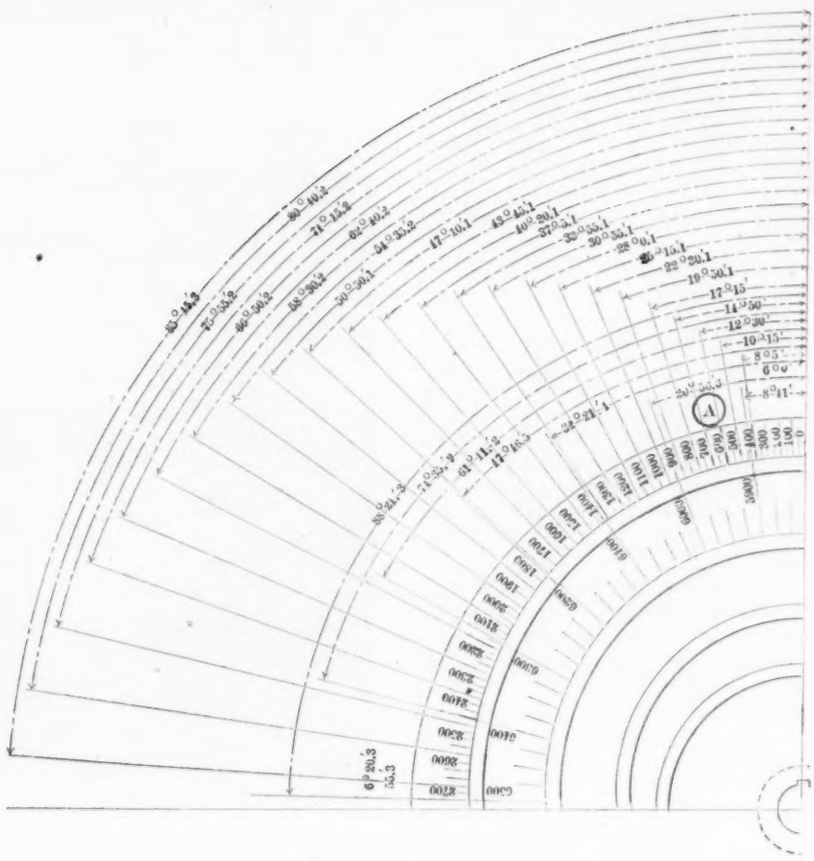


FIG. 7. PART OF A GOVERNMENT DRAWING OF A RANGE DIAL.

A BACK-FACING TOOL.

Figs. 14 and 15 show an elegant little tool for back-facing pieces to length when the face to be surfaced is inaccessible, as it will be seen to be in the piece of work shown in the lathe in Fig. 14. The

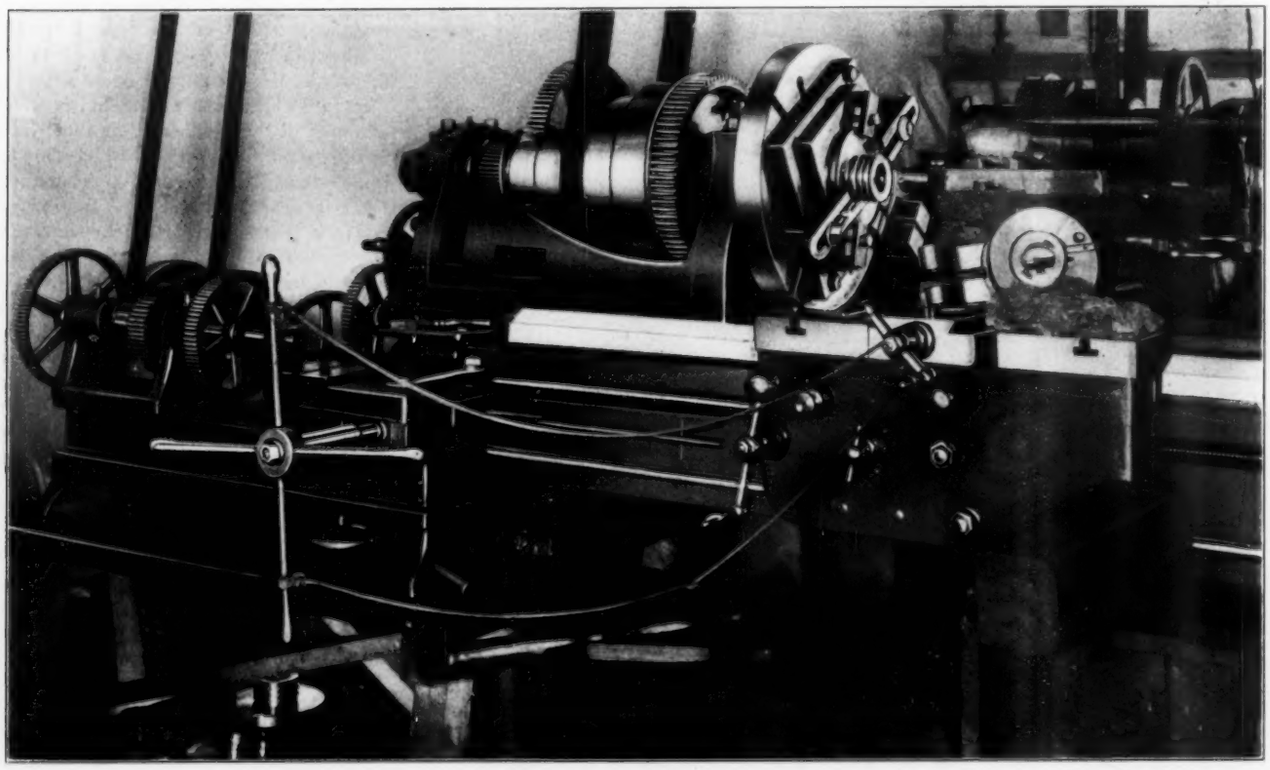


FIG. 8. CUTTING A STEEP PITCH INTERNAL THREAD.

tool is better shown in Fig. 15, the facing cutter being shown at *a*. Its bar, which fits the previously drilled and reamed hole, has a screw thread cut upon it, on which is mounted a graduated dial *b* reading to thousandths. A gage being inserted between the tool and dial, the latter is screwed up to contact and the reading noted. The tool is then removed, the dial is screwed back, the bar is placed in the hole to be faced and the tool is re-inserted. As the facing goes on the dial is screwed up to contact with the work, and when it reads as noted with the gage in place, the work is complete. F. A. H.

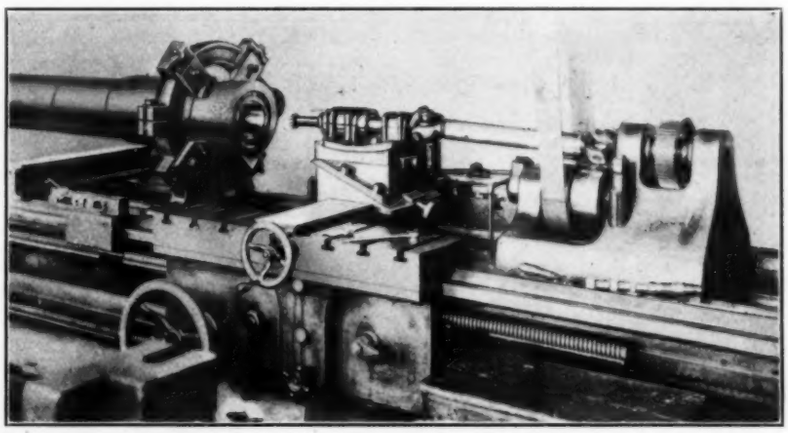


FIG. 9. MILLING THREADS IN THE GUN BREECH.

A considerable quantity of phosphorus may be put into molten copper, with which it readily combines, without bad effect; but if the proportion exceed 0.5 per cent. the metal becomes red-short.

The Demand for Denatured Alcohol—Testimony before the Congressional Committee.

The result of the hearings that have been held before the Ways and Means Committee in the effort to secure free alcohol in the arts and sciences has been the means of bringing out much very interesting information, as to the extent to which alcohol is employed either directly or indirectly in the various everyday industries. For instance, from the evidence offered it was gleaned that the use of wood alcohol is extending to some extent in the manufacture of smokeless powder. The Government withdraws free of tax about 1,500,000 gallons of alcohol for the use of the Navy Department and some 200,000 gallons for the War Department. That is free of tax under our laws.

The Commissioner of Internal Revenue, Hon. John W. Yerkes, stated that he had been surprised to find the amount of methylated spirits (which is wood alcohol) that is used in making smoke-

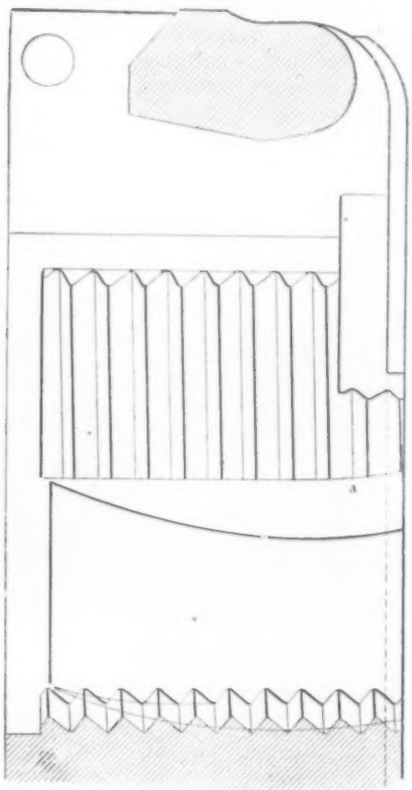


FIG. 11. SECTION OF BREECH OF GUN.

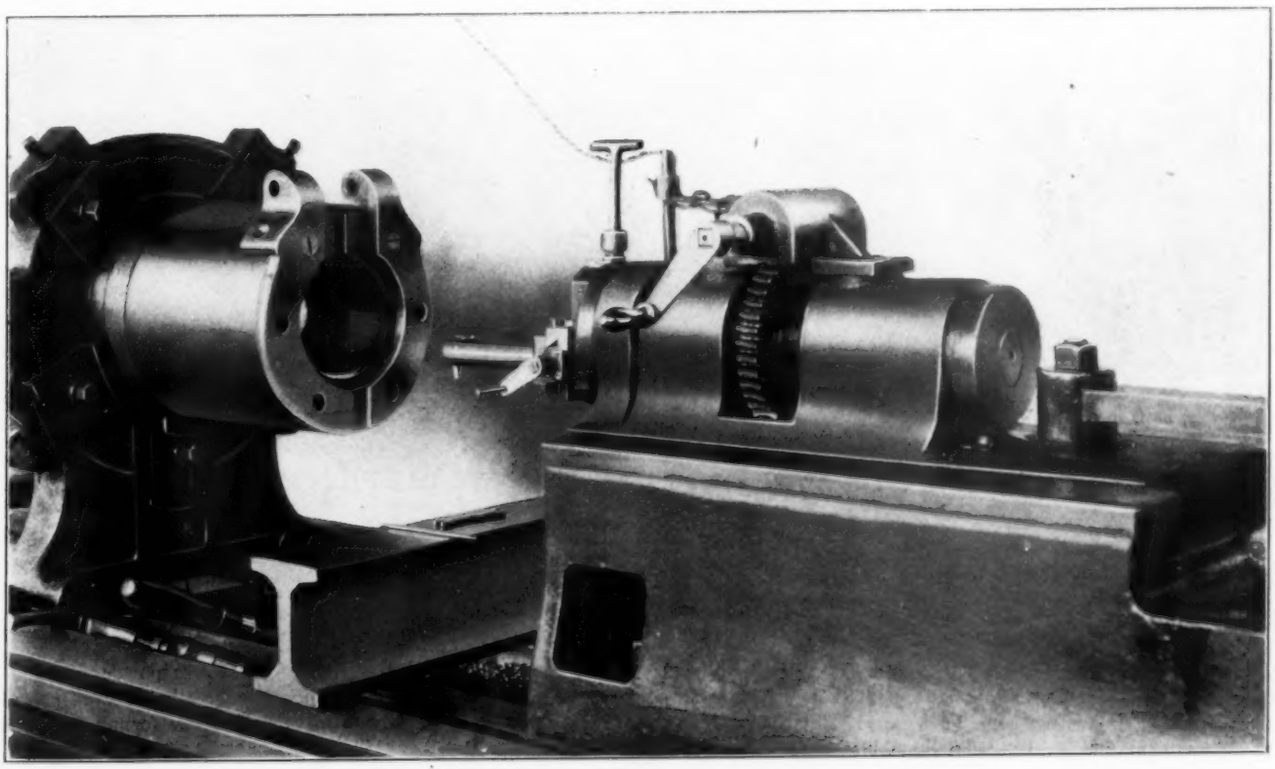


FIG. 10. SLOTTING OUT THE INTERRUPTED THREADS OF THE GUN BREECH.

less powder in Great Britain; this would seem to indicate that it could be used in this country, if the grain alcohol were denatured by the use of wood alcohol as an addition to it. For instance, 1901 returns show that in Great Britain, for fulminates, smokeless powder, and other explosives, including the War Office and Admiralty, 48,000 gallons of these methylated spirits were used. How much of straight grain alcohol was also used does not appear.

In Great Britain the laws have certainly been reasonable and liberal with regard to the use of this untaxed alcohol. The total used, including the untaxed denatured alcohol was 5,500,000 imperial gallons, while in Germany there were used 73,635,249 gallons.

The Grange associations are also largely interested in the question because of the possibilities of the use of alcohol as an illuminant and as a motor fuel for internal-combustion engines, which are coming into such general use on the farms on all parts of the country. During the past few years these engines have become very popular with the farmers, by whom they are used for running all kinds of farm machinery. It is a fact that one of the largest implement-manufacturing companies of the country is arranging to place on the market farm traction engines operated with the internal-combustion motor, for use in many kinds of farm work now done by horse-power.

It is stated, and on good authority, that one industry has been driven out of the United States into Canada because wood alcohol could not be substituted for grain alcohol, and that was the manufacture of fulminate of mercury for the making of blasting caps, etc.

There are many formulas for the manufacturing of smokeless powder, a number of which specify ethyl alcohol as the solvent to be used. The formula adopted by the United States Government calls for ethyl alcohol, and very large quantities are now annually withdrawn free of tax from distillery bonded warehouses

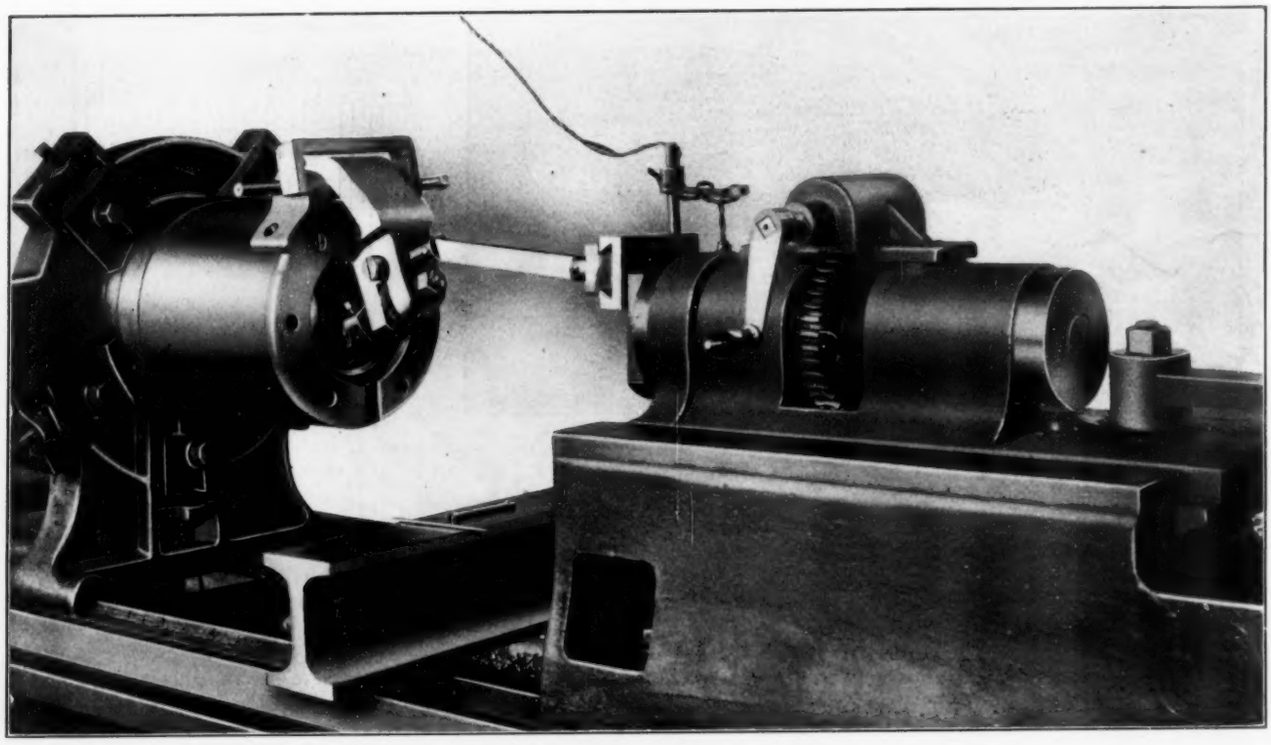


FIG. 12. COMPLETING THE SLOTTING OF THE BREECH.

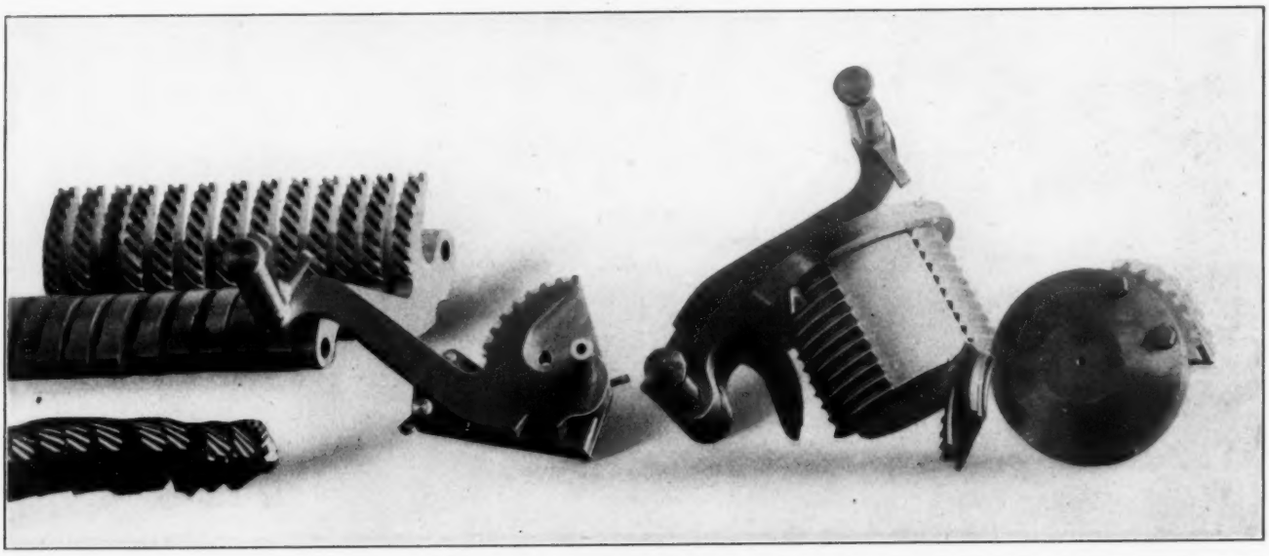


FIG. 13. BREECH BLOCK ASSEMBLED AND IN PARTS.

for that purpose on application of the Navy Department; the quantity withdrawn during 1905 amounting to 1,676,000 for that Department alone.

Grain alcohol, owing to its excessive cost, is not used in the United States for producing the various brands of smokeless powder sold for sporting purposes. Since, however, it is stated upon the highest authority that only the highest grades can be made by the use of grain alcohol as a solvent, it can readily be seen that large quantities would be used if it could be obtained free of the tax.

The measure was urged by representatives of the Detroit Board of Trade in behalf of the large engine manufacturers of that locality, in which it could be used as a motive power. It is stated that these works surrounding Detroit will in 1906 alone produce enough gas engines for automobiles, marine, pumping, and other uses to consume 200,000 gallons of fuel a day. The use of alcohol would be preferable for the reason that the source of supply would never be likely to give out, and this would do away with the constantly growing fear of a possible shortage of fuel in the near future. It is stated that, as a power producer, alcohol is about equal in strength to gasolene; it is cleaner, and there are no left-over products of combustion, and the odors arising from its use are not unpleasant.

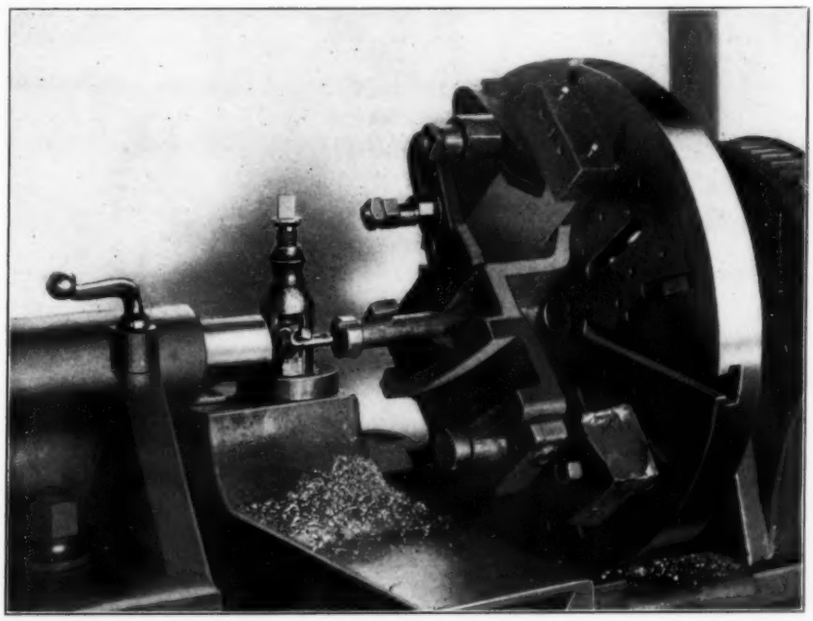


FIG. 14. BACK FACING TOOL IN USE.

INVESTIGATION OF THE ALCOHOL MATTER BY AN AMERICAN GAS ENGINE WORKS.

One of the most important witnesses was Leonard B. Goebbels, representing the Otto Gas Engine Works, of Philadelphia, who told of his experiences in building and testing engines operated on grain alcohol. That concern employs about 250 men in the construction of gas and gasolene engines exclusively. They are the United States branch of the Cologne works, and they turn out about 1200 engines a year, mostly of the medium and larger sizes, aggregating about 20,000 horse-power. Of that number about 12,000 horse-power are operated on liquid fuel, gasolene distillate, etc., consuming, when run on an average of 8 hours per day, 6,000,000 gallons per year, that is in the United States alone.

Three years ago the increase in the cost of gasolene caused the concern to look about for a cheaper substitute. This resulted in a visit to Germany, where it was found that denatured alcohol was very largely used in internal-combustion engines. At that time, in 1903, the German factory was building and selling alcohol engines at the rate of about 20 per month, out of a total output of 200 engines per month. This comparatively small number was due to the fact that at that time they were turning out a great number of larger engines, up to 3000 horse-power.

During Mr. Goebbels' visit several shop tests were made with the alcohol engines, varying in size from 10 to 30 horse-power. The result then showed that about 20 per cent. more power could be secured on a given engine than could be secured on the same engine with the use of gasolene. This was due to the fact that alcohol, while it does not have the same heating value per gallon, yet it can be compressed to a much higher degree without any danger of spontaneous combustion. The thermal efficiency is therefore much greater. The consumption of alcohol per horse-power was found to be about the same.

An investigation at that time showed that one central station in Berlin alone had contracts for supplying 1011 alcohol engines and at that time there were being turned out for actual use, new engines at the rate of about 50 or 60 per month throughout Germany. The Government of Germany took an active interest in the matter and offered a prize for the most perfect alcohol engine for military purposes and out of 8 or 10 engines of different makes which had been tested the Otto engine secured the prize, which was offered by the Emperor personally. There are now in operation throughout Germany about 5000 or 6000 alcohol engines.

A. F. TENNILLE.

Washington, D. C.

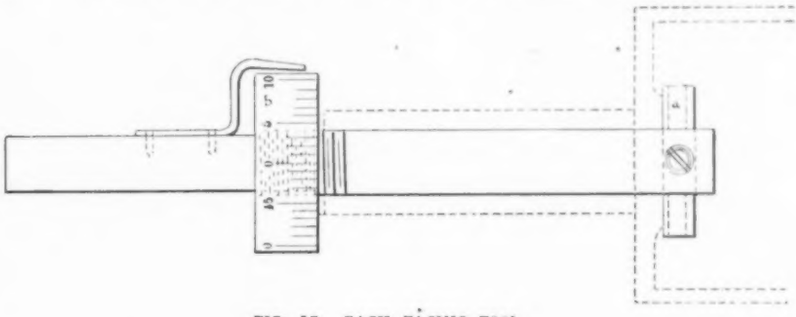


FIG. 15. BACK FACING TOOL.

The Donnell-Colvin Company, 256 Broadway, New York, has assumed control of what is known as the "Mechanical Index," which has previously been published by the Industrial Publishing Company. It is the plan of the Donnell-Colvin Company to improve it, and it will be issued in sections, each devoted to a certain class of machinery, or it will be supplied complete. Confined, as it is, to mechanical matters, and being handled by men who are conversant with such matters, it is naturally a better index than most of such publications. A special effort will be made to keep it strictly up to date, and there will be sufficient knowledge of machinery to distinguish clearly between the milling machinery which is used for making flour, for instance, and that which is used for milling steel and cast-iron parts of machinery.

A "water-finder," Mr. Child, of East Bergholt, near Ipswich, who is in great request by local councils for his advice as to where to sink wells, does his work with a watch spring instead of the ordinary hazel twig.—*The Machinery Market.*

Osborn's File and Twist Drill Factories, at Sheffield, England.

BY I. WILLIAM CHUBB.

The name of Mushet needs no introduction to any engineer. R. F. Mushet, the son of David Mushet, discoverer of the Scotch Blackband ironstone, was of course the inventor of the well-known self-hardening steel. As a metallurgist he was experimenting in 1868 when he found that a trial steel bar containing tungsten became hardened after being heated without the usual quenching in water. The manufacture of this steel was taken up in 1871 at the Clyde Steel Works, Sheffield, by Samuel Osborn & Co., who have continued the industry, and, so as not to be behind the times, introduced modern self-hardening high-speed steels. This firm now has three works in Sheffield, including the Clyde Works at the Wicker, and the Brookhill and Rutland Works. In all they engage the attention of about 1000 men.

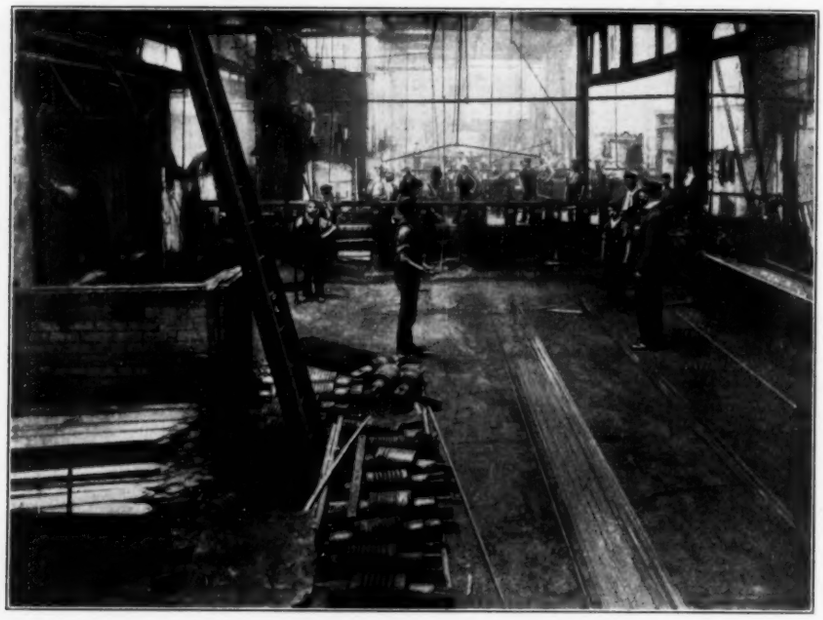


FIG. 1. THE ROLLING MILL.

THE THREE PLANTS AND THEIR PRODUCTS.

At the Wicker works, where are also the chief offices, the production of crucible steels and the hammering and rolling of bars of all sections are perhaps the most important businesses; but in addition are undertaken the manufacture of locomotive, wagon, and motor-car springs, the fitting up of agricultural implements, and the manufacture of engineers' small tools, such as hammers, chisels, etc., and of saws of all kinds. Here also are manufactured high-speed twist drills and milling cutters by methods which will be described later. The Brookhill works are confined entirely to the production of files of various kinds and at the Rutland works steel castings are produced up to about 25 tons, including steel gearing, colliery wheels of various kinds (fitted with axles), roof bars, locomotive castings, shoes and dies for gold mining, manganese steel jaws, etc., hydraulic-press cylinders and other hydraulic machine castings, castings for electrical purposes, and so on. At the Wicker works crucible cast steels of various qualities are made, and in addition the Mushet high-speed cutting steel is produced. These steels are identified by colored labels, each quality having a separate color, while each bar is also stamped with a number which indicates the quality, with another number for the temper. For tool steels there are six tempers, ranging from material which welds easily up to tempers for small taps, reamers and planing and turning tools, and the temper most suitable for engraving tools, razors, etc. Thus each bar is known not only by the color of the label, but also by the stamp, which, in addition shows the temper.

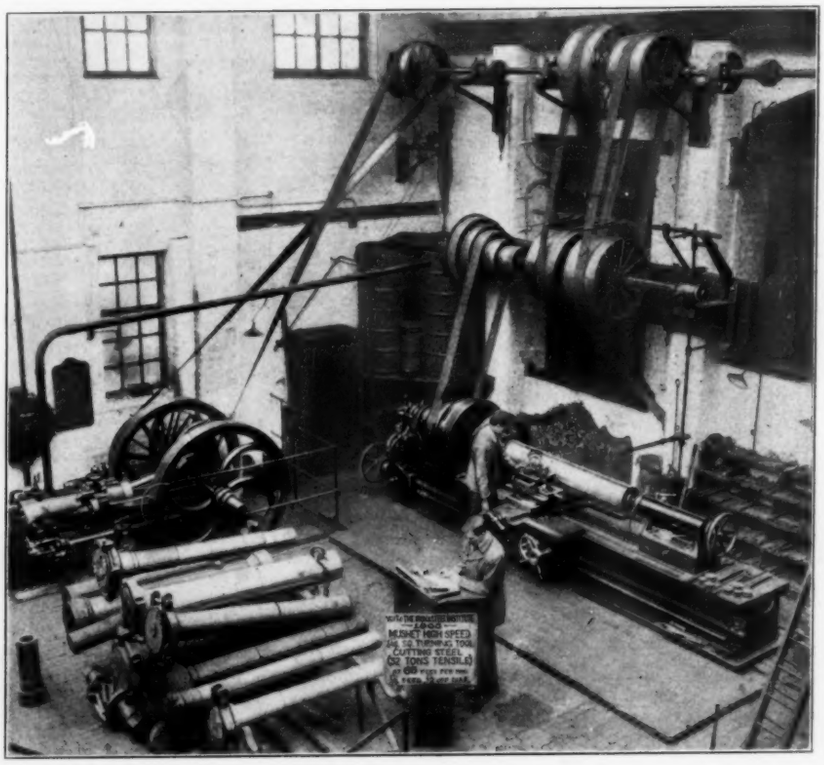
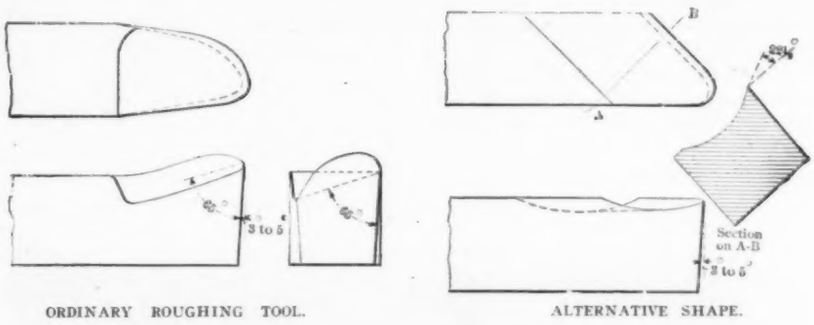


FIG. 2. LATHE FOR TESTING HIGH-SPEED STEEL.

THE WICKER WORKS.

The Wicker works, like others, are in process of transformation, and although this change is constantly occurring in a natural manner, progress has recently been accelerated very greatly. At the Wicker works a special gas-producer plant with gas engines has recently been installed. Two Crossley gas producers of 250 h.p. and 150 h.p. have been erected, together with gas engines which have displaced steam engines. The coal is bituminous nut slack costing from 6s. to 6s. 3d. (say $1.50) a ton (2240 lb.), delivered at the railway station. The special feature of the producer is perhaps the cleaning of the gas it generates. This, after passing the coke scrubbers, is drawn through a centrifugal tar separator, where it meets jets of water. The separator mixes the gas and water, and the water, thus broken up, picks up the tar which, by centrifugal force, is thrown outward, passing away into a tar sump. The gas thus cleaned then passes through sawdust scrubbers, where it is further cleaned and dried. The producers, by the way, have a special



ORDINARY ROUGHING TOOL. ALTERNATIVE SHAPE.

FIG. 3. RECOMMENDED SHAPES OF MUSHET HIGH-SPEED TOOLS.

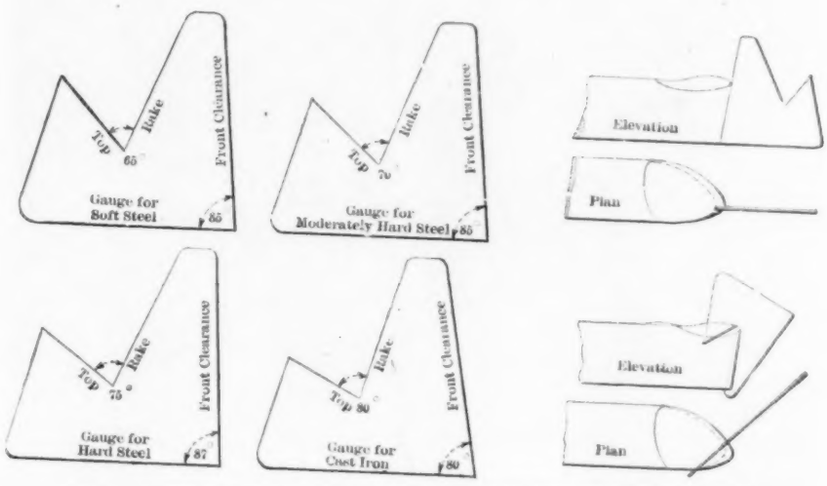


FIG. 4. ANGLE GAGES FOR TOP AND FRONT CLEARANCE OF ROUGHING TOOLS.

poking arrangement. The poking holes are sealed with balls about 6 inches in diameter, which are held in position by spiral springs. In each ball there is a hole about 1¼ inches in diameter, through which the poker is inserted. By this means poking can be done at various angles, and when the operation is finished the attendant, in withdrawing his poker, pulls the ball over so as to prevent the escape of gas. The main engine is a Tangye 3-cylinder vertical of about 200 b.h.p., having direct coupled to it the dynamo which is used for power purposes, not for lighting. The pistons are 16 inches diameter by 19-inch stroke, and the engine runs at 210 revolutions a minute. The Otto cycle is used and the governing is done by regulating the supply of gas at the throttle valve, not on the hit-and-miss principle. It will be seen there are three impulses for two revolutions of the crankshaft. The engine is started by compressed air by a smaller engine, the pressure being 160 lb. In the same power-house is a spare horizontal gas engine of 70 h.p. with cylinders of 16½-inch bore by 24-inch stroke. This drives a compound-wound dynamo by belt. The circulation of the water through the jackets of these engines is assisted by a centrifugal pump. The power-house containing the plant will also permit duplication of the present machinery. Further provision for the supply of power will be found in the somewhat scattered set of engines using both steam

VIEW 5. VIEW IN TWIST-DRILL DEPARTMENT.

and gas. Thus an old beam engine with a 28-foot flywheel is being taken out, another horizontal gas engine of 130 b.h.p., with pistons 22½ inches in diameter and 28-inch stroke, taking its place. Then a horizontal Corliss engine of about 200 h.p. drives two rolling mills, 16- and 12-inch, respectively, while a vertical steam engine is to be replaced by a 50-h.p. electric motor. A beam engine still in use drives three rolling-mill trains Fig. 1, one mill being 18-inch and the other two 10-inch. These mills will roll sheets and all sections, including squares and rounds, and specials for agricultural implements, spring steel, etc. The steaming arrangements comprise seven boilers, including five Lancashire boilers, 28 by 7 feet. One boiler, however, is to be discarded as soon as the 130-h.p. gas engine is started. At these works another gas engine of about 30 b.h.p. is installed for the special purpose of driving a lathe on which are tested the high-speed steels.

A TESTING LATHE.

This lathe is illustrated in Fig. 2 and is of 16-inch centers, that is, 32-inch swing, with 5-step cones, the diameter of the largest being 34 inches, the smallest 12 inches, and each step being 6 inches wide, the countershaft having two speeds. Thus from the lathe alone 10 speed changes can be obtained, while the speed of the engine itself can in turn be varied from 160 to 210 revolutions per minute. The following are particulars of a recent test of a 1¼-inch square Mushet high-speed tool:

Quality of Steel Turned.	Tensile Strength Tons per Sq. Inch.	Feet per Minute.	Reduction of Diam.	Feed per Revolution.	Duration of Test, Min.
Siemens-Martin.	28	65	1½ in.	⅛ in.	30

Remarks—When the tool had been at work ten minutes it was noted that the point was red hot. It continued to work satisfactorily at this heat until the end of the test, when the cutting edge was examined and found to be quite keen.

The Mushet high-speed steel is made on much the same lines as Mushet self-hardening steel and is said to be the result of more than 200 different trial mixtures and hundreds of lathe trials on various metals. Turning tools of this steel should be hardened by heating the nose or cutting end to a welding heat, after which they should be cooled by means of a blast of air (compressed air preferred) or a bath of whale oil. At the Clyde works experiments were made which showed that air at a pressure of about 60 lb. was best in the ordinary course. It is recommended that after tools are forged the smith should leave them in the hearth, allowing them to soak through the night, not only to anneal but also to take out forging stresses. The heat for the hardening process should then be applied to the cutting points only. The standard shapes recommended by the firm for roughing tools are shown in Fig. 3, while in Fig. 4 will be found an illustration of angle gages for top rake and front clearance of ordinary turning tools for roughing various metals.

THE TWIST DRILL DEPARTMENT.

In the twist drill department, Fig. 5, drills from 0.2-inch up to 4⅞ inches diameter have been produced, tools of the larger size being for drilling propeller bosses. In fact, drills are stocked of all sizes from 3/16 up to 3-inch. For the production of these drills are used a large number of specially designed machines, principally by Reinecker and H. W. Ward, Birmingham. The steel bars are first cut by hack saw from annealed stock. They are then centered and countersunk in a Pratt & Whitney centering machine, turned in the lathes, and pointed. Fluting is done in the usual way with formed milling cutters, both grooves being produced simultaneously with one cut only over each length. Five fluting machines are employed. The backing-off or relieving, too, is done by milling, a special machine being also used for relief-pointing the large drills. Next the tangs are milled, two cutters operating on each drill at once, the drill being then dressed off and marked for name of the firm, etc., by being rolled in a machine. The blanks are turned at speeds varying from 80 to 160 feet a minute, a traverse of 90 to the inch leaving a sufficiently smooth surface. For milling the flutes the cutters revolve so that the edges make about 80 feet a minute. For hardening, the firm have their own appliances, which are thought to produce specially clean results, the drills being heated without scaling. They are next sand-blasted and put in one of the four grinding machines, where the bodies and shanks are treated. They are all ground on dead centers and gaged by micrometer. Next the tips or points, after being roughed down on a stone by hand, are treated in three special grinders.

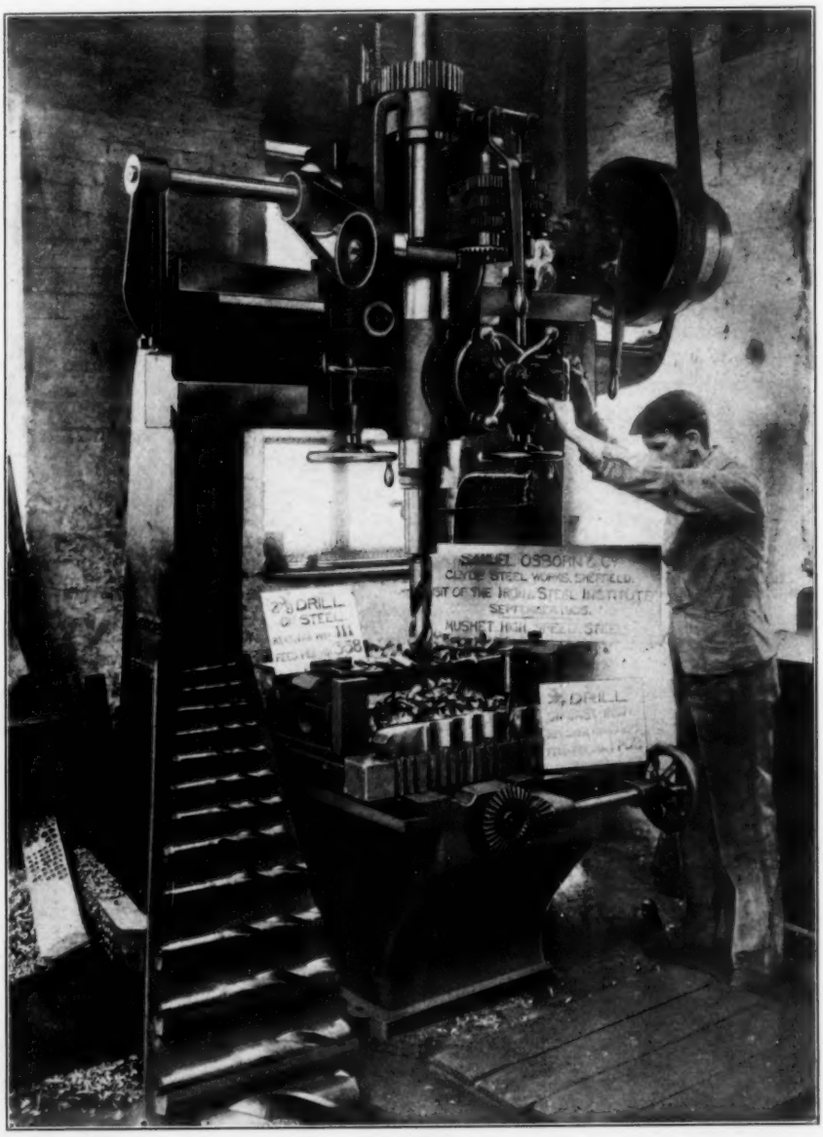


FIG. 6. A SPECIAL DRILLING MACHINE.

HIGH-SPEED MILLING CUTTERS AND HARDENING HINTS.

In the same shop are produced high-speed milling cutters of practically every kind up to 16 inches diameter. The plant here, however, is of much the usual kind, but it includes a special machine for grinding the hole and face of the cutter; it has a magnetic chuck and the two heads move in directions square with each other. Another special tool is a relieving lathe for milling cutters. Here, as is usual, a cam and a spring control the position of the slide rest. Among the problems solved in this department has been the hardening of high-speed milling cutters 16 inches in diameter and cutters 12 inches long by 8 inches diameter. Taken from the experience of the firm, a few hints as to the hardening of forming tools, dies and milling cutters may be given. A satisfactory way of preventing blistering is to heat the tools in a lead bath. In the case of forming tools and tools of a special shape it is advisable that they should be ground or filed exactly to shape before subjecting them to the heat-hardening process. Milling cutters may be protected by filling the teeth with fire-clay.

A SPECIAL DRILL PRESS.

Each tool thus produced is carefully tested in a special drilling machine, of which an illustration is given in Fig. 6. It will be seen that this machine has two uprights, which are 2 feet 8½ inches apart. On their face is bolted a cross-slide carrying the drill headstock, which is adjustable by means of a hand wheel, rack and pinion. The two standards are tied together at the base by a strong bracket, which carries the table, which is 2½ feet long by 18 inches wide, having a cross adjustment of 10 inches. Around this table is a trough, as usual, to catch the lubricant, and the necessary pump and piping are attached. The machine is at present driven from a 2-speed countershaft, but it can easily be arranged for electric driving. The 3-speed cone pulley has diameters of 15, 18 and 21 inches for a 4-inch belt, and it will drive either direct to the horizontal shaft or through double gearing which is used for testing the larger drills. The spindle speeds range from 76 to 525 turns per minute. The hard steel spindle is 3 inches in diameter and is driven from the horizontal shaft through miter and spur gears. It is balanced and will run up and down quickly by hand, while the thrust of the cut is taken by a ball bearing at the bottom end. The maximum distance from the spindle to the top of the table is 27 inches, and the vertical traverse of the spindle is 12 inches. The feed motion has six changes, varying from 0.010 to 0.033 inch per turn of spindle. The feed can be altered without stopping the machine and can also be released instantly, no matter how heavy the cut.

The following table will give an idea of the capacity of the machine, and also of the cutting qualities of the Mushet high-speed twist drills:

Size of Drill (diam.)	Material Drilled and Thickness.	No. of Rev. per Min.	Feed in Inches per Minute.
2 5/16 in.	Siemens Steel .30 C 3 in. thick.	111	3½
¾ in.	Gray Iron 3 in. thick.	725	17

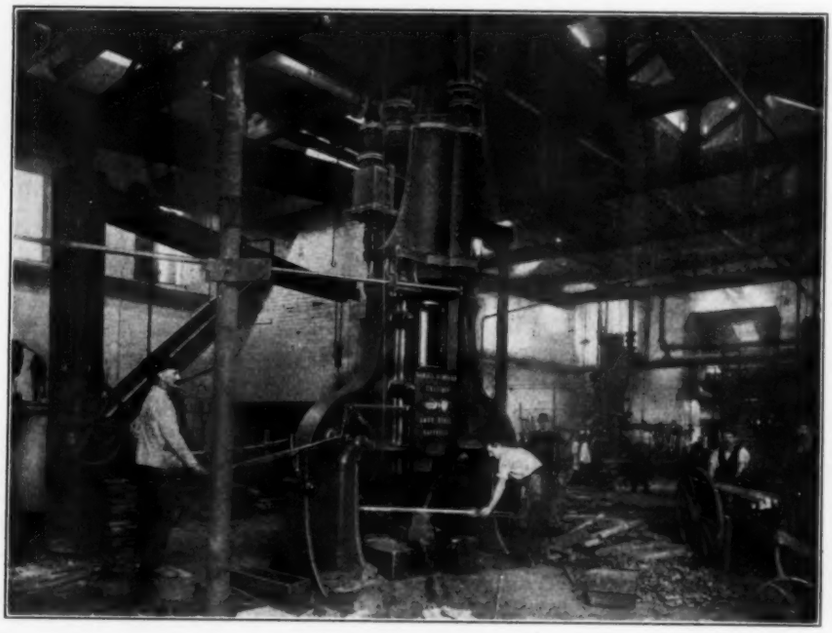


FIG. 7. THE FORGE SHOP.

THE FORGE AND THE CRUCIBLE STEEL PLANT.

At these works, in the forge, Fig. 7, are a number of steam hammers, the sizes varying up to 30 cwt., used for forging crucible steel ingots. Besides the roughing and finishing rolling mills already mentioned, there are also spring-forging machines, with a special department for the production and testing of railway, and in fact, springs of all kinds. The usual blacksmith's shops and annealing furnaces are also to be found and a general smithy for repairs. With this part of the works, however, it is impossible to deal in detail. Some notes may, however, be given of the plant used for the production of crucible

FIG. 8. HAND FILE CUTTER AT WORK.

FIG. 9. THE FILE STEEL WAREHOUSE.

steel. This department has the usual melting holes to the number of about 84, with two crucibles to each hole. Three rounds are obtained from each pot, 66 lb. in the first, 48 in the second and 56 in the third. The cheaper qualities of steel are made in the third round in case the pot bursts. One round takes from 2½ to 3½ hours, although some qualities may take even 5 hours. The ingots thus produced are rough forged and cogged, then pickled in dilute sulphuric acid and examined so that any defects on the surface may be ground out. The crucibles themselves are molded by hand, the clay being first trodden by foot. Four sorts of clay are used, the principal being Derby, white and common. Tempering or blend is of course of importance for lasting purposes. Machine-molded crucibles have been tried, but the hand-molded ones have been found more satisfactory. The pots are dried in front of the furnaces for a week, then stand at the back for another week, are placed on shelves for a third week, and before use are annealed in a furnace, 24 at a time. In this furnace they are covered with coke, being put in say at 9 o'clock one morning and taken out at 6 o'clock the next morning.

FIG. 10. VIEW IN FILE-GRINDING DEPARTMENT.

FIG. 11. THE FILE-CUTTING SHOP.

THE FILE WORKS.

The Brookhill works are used for the production of files only, the output at present being about 43 tons a month. At the outset it is doubtless worth noting that for this industry machinery has almost entirely displaced hand labor. The latter, however, is still used for very small and thin files, which sometimes bend under the blow produced by the machine. It is expected, however, that for this work girls only will be employed in the future, and in fact no men are now being trained or apprenticed to the industry. During the last few years a number of official regulations have controlled the workshops, many of them formerly no better than hovels, in which the hand-file trade has been carried on. The effect has been to improve the conditions and also to restrict the trade. A typical hand-cutter at work, old style, is shown in Fig. 8. Messrs. Osborn, however, still employ outside from 12 to 20 people, who are engaged on special work. At the Brookhill works they have about 120 workpeople, men and women. Owing to the introduction of machinery and the improved facilities given to employees, it is now possible for a man to do in one day work which would previously have taken him four or five days. Thus quite recently, in one week four men, working overtime only 1½ hours each day, did 115 days' work on the old standard. The new system of hardening furnishes an instance of increased facilities offered to the workmen. The old method was to use a coke fire with bellows. The method now employed is to use a gray-iron pot full of molten lead. The pots have a large capacity and this leads to the dispatch of work, while the heating of the files is much more uniform. In fact, no such results could be obtained by means of a coke fire. Four or five files, according to size, are allowed to soak in the lead bath at a time. As one is taken out another is put in, the heats being worked in rotation so that all the files receive the same amount of treatment.

Reference has been made to the "day's work." There are various methods of estimating this, but according to what is known as the "old time standard," which was based on the record of average work, a day's work would be taken as the hardening by one man of 12 dozen 14-inch files. As has been suggested, the men will now do from four to five times the number. The system was modified somewhat in 1873 and the men are now paid by piece work, although the task is practically set according to the "day's work." Obviously in one day a man may do several days' work. The same system is employed in the cutlery trade in Sheffield.

PREPARING FILE BLANKS.

The steel used for files is rolled at the Wicker works and stocked at Brookhill. It is first melted in crucibles, cast into ingots, and then worked into bars of the right section by means of steam hammers and rolling mills. The bars are taken from the file-steel warehouse, Fig. 9, and cut by shears ready for forging. For heating the file blanks before forging coke furnaces are at present used, but are to give way to gas. Steam hammers are at present employed, but these again are to be replaced by power hammers. In these machines the tup is held by a leather band, the blow being delivered by the spring. Each hammer in use has a jet of air blowing on the anvil to remove any scale that otherwise might be driven into the file. After forging, annealing is the next process. This takes about 24 hours. Two furnaces are used, which are at present coal-heated, but a gas-producer plant is to go in as soon as the boilers now employed for the steam hammers can be taken away. It should be noted that a few files are forged by hand at a special small forge. The grinding machines, Fig. 10, to which the file blanks are next taken, are belt-driven, the stones being 5 feet in diameter by 12 inches wide. A row of files is reciprocated under each stone, the tangs being secured by an iron bar while the other end rests on a rubber strip. Eight or ten files are thus treated, according to their size. A cam motion is used to bring the stone across the row, the object of course being to prevent grooving. The files are moved in a water bath and there is a further plentiful supply of water; otherwise sparking due to grinding might cause heating and the material would be chilled. Each stone has a dressing arrangement in front, which is worked across its face by hand. The files are afterward touched up and the tangs are ground by hand on a stone, one finisher being provided for three grinding machines. In addition certain files, such as half-rounds, rounds, etc., are ground by hand at one end of the grinding shop.

FILE-CUTTING MACHINES.

The works include three cutting shops, one of which is shown in Fig. 11. These shops are bright, airy and light, each machine being fitted with an electric lamp.

As the lamp must necessarily be brought down close to the worker, the disadvantage of a gas jet from a health point of view is plain. For cutting purposes vibrating machines to the number of sixty are used, suitable chisel tools being driven by means of wood pulleys and bevel gear. In each machine, as shown in Fig. 12, the bed carrying the file receives its traverse from a screw, into which a white metal nut is dropped. Each bed fits in a half-round slide, which therefore provides any twisting adjustment necessary. Each side has a stop which can be set, according to the length of the file, to catch a lever release and at the right time shift the belt to the loose pulley. Driving in each machine is from a cam shaft which gives two chisel strokes to each revolution. Barrel-shaped india-rubber is used for the spring of the machine, pressure being regulated through a hand-wheel by a screw which compresses or releases the spring. This, the Weed machine, is made solely by Samuel Osborn & Co., Ltd., and supplied by them to other file manufacturers. It is manufactured in a range of eight sizes, to deliver from 720 to 1280 blows to the minute. Half-round files have special beds, one for each side, and a series of cuts in ten or eleven rows are given over the curved surface. Round files are treated in much the same way, the chisel being inclined to the axis. The resultant spiral effect, compared with the ordinary round file, is shown in Fig. 13, the spiral file-cutting machine being illustrated in Fig. 14. Formerly a 6-inch bastard file required in its production ten cuts. In the machine used only one cut is needed, the file being rotated during the process of cutting. The Weed machine will cut files up to 20 inches long and has a presser in front of the tool which keeps the file down and helps, with the half-round bed, to adjust it in position. The machines do either fine or coarse work, but for smooth files the men in charge are specially skilled. When the files are cut the ends are sheared off and ground on an emery wheel.

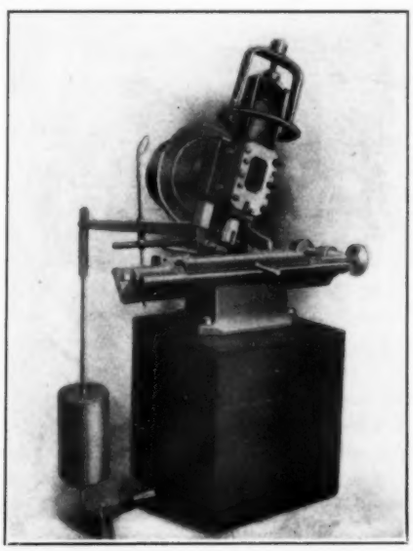


FIG. 12. FILE-CUTTING MACHINE.

For treating worn chisels special whetting machines are used, each having a power-driven lead disk. On this is smeared emery and oil, the whole revolving on a vertical spindle. Naturally this saves time when compared with whet-stones.

For the production of rasps a tool is used to dig out the metal, being automatically traversed across the face of the blank while the latter passes under it. The head holding the tool is inclined from the vertical and held in place by a spring. The tool is driven across the blank by a ratchet, a stop throwing the pawl up and providing for the return stroke across the rasp. Here again the pressure is regulated by a screw.

THE HARDENING DEPARTMENT.

In the hardening shops, as has been formerly stated, lead pots are used. Each will take at least four 16-inch files. The chief interest is in the treatment of half-round files, which, owing to their unequal cross section and further variation of section according to length, are very difficult to heat uniformly. The tendency of the file is to bend. The man therefore gives the file an initial camber in the opposite direction, making it first concave on the half-round edge. Thus a 16-inch file may receive about ¼ inch of camber. In the bath the files float and are gripped by tongs. At the right heat, which is judged by the eye of the workman, who has no pyrometer, the file is taken from the pots and dipped in a saturated solution of common salt. It is then examined for straightness and usually set with a lead hammer and lead blocks, water being thrown on to assist the process. In passing through the salt water the file produces a peculiar whistling noise, for which the man listens. The skill of the man is shown in giving the tool the necessary amount of camber before dipping and in the correct judgment of the heat.

The files are previously treated with blacking of a carbon composition to prevent the lead getting into the teeth. Therefore from the hardening process they are taken to a sand-blast, where a jet of steam applies a fine stream of sand to remove the blacking. As soon as the necessary arrangements are completed compressed air will be used instead of steam for the supply of this blast. Before the use of the blast it was common for women to do the cleaning, the files being put on a bench and scrubbed with sand. The work was of course extremely unpleasant and

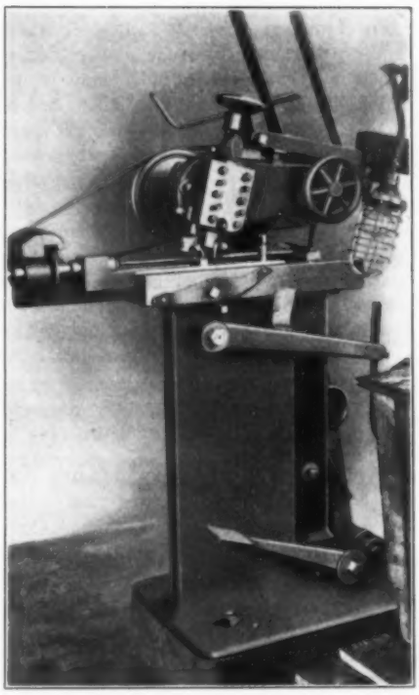


FIG. 14. SPIRAL FILE-CUTTING MACHINE.

the present arrangement is undoubtedly better from a humane point of view. After the sand-blast the tang is tempered and finished in another lead bath and the file is oiled over, only the best Stettin colza oil being used. This work is undertaken by women and after it has been done the file is ready for the warehouse.

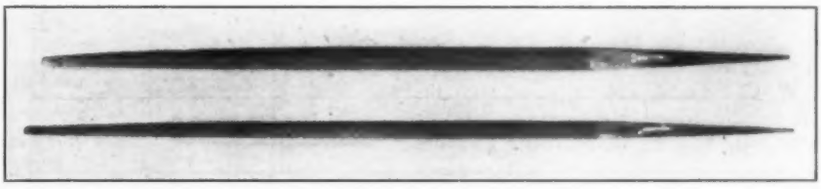


FIG. 13. ORDINARY AND SPIRAL-CUT ROUND FILES.

INSPECTION OF PRODUCT.

Before being stored each file is examined and proved. It is rung for cracks by being dropped lightly at one end on a metal block. It is then proved with a piece of hardened steel, about ¼-inch diameter by 4 inches long This is drawn down the teeth, and if the file is found to be sufficiently hard, it is then examined for straightness and flatness and again for flaws. These may possibly be found, not only in the material, but also in the cutting, as occasionally, a chisel may work loose owing to the jar, the result being crossing of the cut. The files, after being sorted out, are wrapped in paper, a layer of which keeps the teeth of one away from the teeth of the next. They are thus secured in dozens at a time. Here, as throughout, great care is taken. A pure rope paper, without earthy matter, is used. Obviously it burns to a very light ash. This paper is always stored in bulk

for at least a month and then hung on racks overhead, so that it may be aired, to prevent dampness. It is possibly worth adding that these files are now placed in cardboard boxes instead of being bound up in paper bundles. The boxes are of course handier for the customer.

For driving the plant at the Brookhill works gas engines are being installed. One engine is of 80 b.h.p., the town supply being used. Arrangements are practically completed for the use of producer gas, however. Another engine of 70 h.p. is to be used for driving the compressor and a special blower for the supply of air to the blank heating furnaces and hammers.

A New Firm of Lathe Builders.

A new firm of lathe builders has lately been formed, under the name of The Cincinnati Lathe and Tool Company. The plant, which is expected to be running by April 1, 1906, is situated in the heart of the machine tool district in Cincinnati, Ohio.

The equipment of machine tools is new throughout, and is the best obtainable.

The concern has purchased the lathe business of the Fosdick Machine Tool Company and it is the intention to specialize on the lathe which in its design embodies the W. T. Emmes patent feed device. This lathe was described and illustrated at page 703, Vol. 28, Part 1, of the AMERICAN MACHINIST.

W. C. Heindel, for ten years with the Cincinnati Milling Machine Company, is president, and A. B. Sowden, who has been building lathes for the past 20 years, is superintendent of the new company.

The National Child Labor Committee, 105 East 22d street, New York City, appeals to Congress to establish in the Department of the Interior, a bureau to be known as the Children's Bureau, the chief duty of which shall be to gather statistics and information bearing upon the welfare of children, especially upon their employment in factories and elsewhere, and to publish the results of these investigations.

In order to temper twist drills for drilling hardened steel, sulphuric acid may be used, the acid, to a depth of ⅛ inch or so, being placed in a flat-bottomed vessel; dipping the point of the drill when hot into the acid gives a point of a great hardness, without affecting the other portions of the drill. If the hardness is excessive so that the point breaks, use less acid next time.

A leather pneumatic automobile tire has been invented and its manufacturers claim that it is water, sand and puncture proof. A company will be formed in Detroit to handle the new tire.—*Compressed Air.*

Studies in Inventive Problems.—XVI.

PROPOSED BY LEICESTER ALLEN AND SOLVED BY VARIOUS READERS.

Another Problem, No. X, is announced at the end of this article.

A criticism of solutions of Problem V, announced at page 165, Part 2, of Vol. 28, has been received from E. C. Noble, Rock Falls, Ill., which will properly find a place here.

I must here make a little explanation:

By some one of those oversights and accidents which occur in the best regulated families, I consigned to the category of "Equivalent and Similar Solutions" a solution supplied by Mr. Noble, which I will present here. I find on looking up the matter, the drawing and description of this solution labeled "Examined and to be Published," but it was misplaced, as aforesaid.

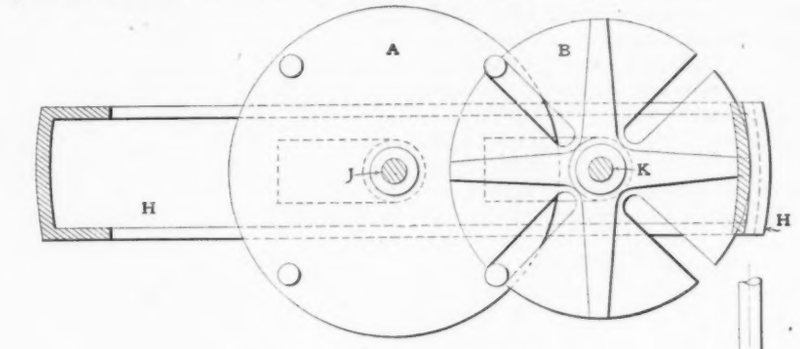
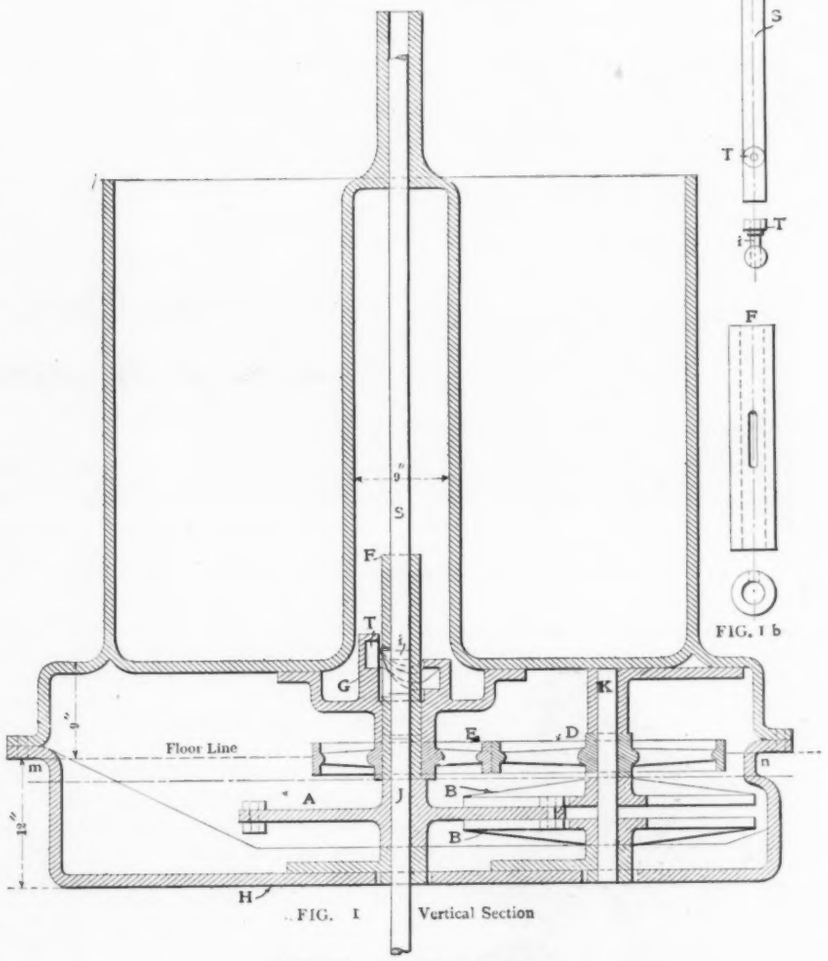


FIG. 1a Sectional Plan on Plane m n



SOLUTION NO. 7 TO PROBLEM V.

The tenor of Mr. Noble's criticism indicates his appreciation of the difficulties of adequately treating the mass of drawings, descriptions and correspondence imposed upon me in the conduct of this series, and I confidently count upon his generous acceptance of the apology I herewith tender.

PROBLEM V, SOLUTION NO. 7, FIGS. 1, 1*a* AND 1*b*. E. C. NOBLE, ROCK FALLS, ILL.

Mr. Noble describes his device as follows:

"The variable rotary motion is obtained by the device shown in plan on *m n*, in which *A* is the driver, keyed to shaft *J*, which is driven by suitable gearing below the ceiling. It is evident that one revolution of *A* will cause *B B* to increase in speed from zero to maximum, and decrease again to zero, four times, and the *rate* of acceleration and retardation will be uniform. *B B* and *D* are keyed to shaft *K*. Gear *D* drives pinion *E*, which is three-fourths the diameter of *D* (in this case *D* is 22 in. diameter and *E* is 16½ in. diameter). This gives the three variations of rotary speed required by the problem. The vertical reciprocating motion is obtained by stationary cam *G*. Pinion *E* is keyed to hollow shaft *F*. Shaft *J* extends upward into *F* to make the parts more rigid. Spindle *S*, which carries the sieve, extends down into *F* far enough to just clear *J* when at the lowest point of vertical movement. Through one side of *F* is a slot. Through this slot is a stud fixed firmly in *S* and on the outer end of which is a roller *T* traveling in the groove of cam *G*. Cam *G* has three ups and downs, thus obtaining the other movement required by the problem. Were I designing this machine to be built otherwise than on paper, I am not sure but I would modify the design of cam *G* somewhat, as the angles of travel are rather 'sudden.' It might be improved by inverting the cam, or lowering it so as to get room for a larger diameter."

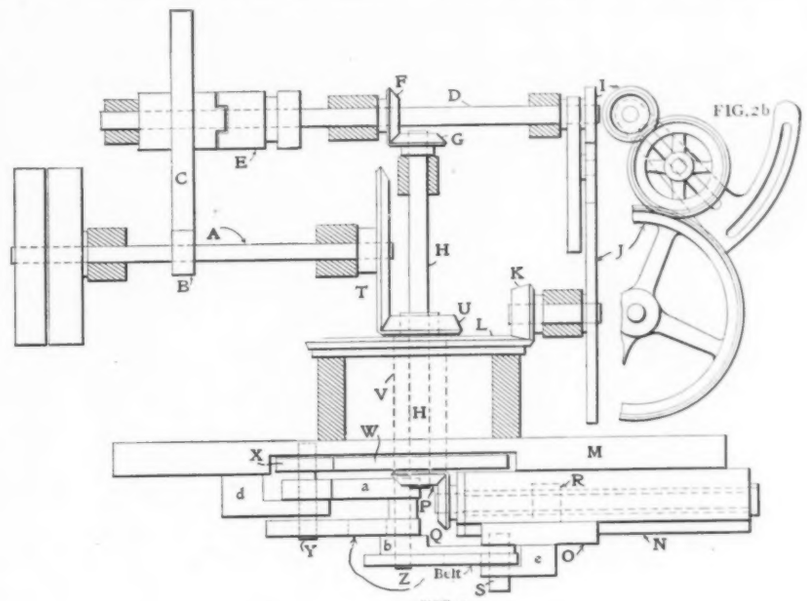


FIG. 2b

FIG. 2

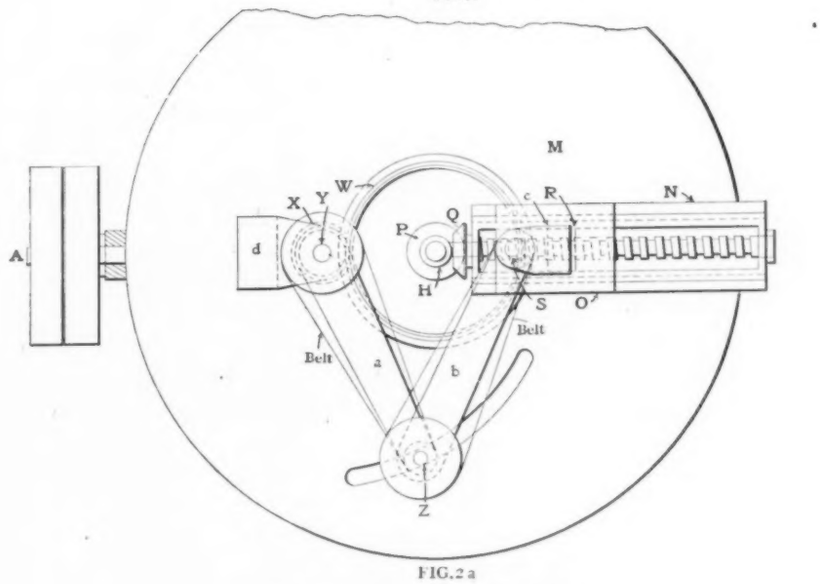


FIG. 2a

SOLUTION NO. 6 TO PROBLEM VII.

Mr. Noble's criticism, above referred to, follows:

"Believing that comment and criticism from those interested in these problems would be beneficial to all concerned, I respectfully offer the following:

"It must be an exacting task to examine and prepare for publication such a promiscuous lot of drawings and descriptions as are submitted to you in solving these problems; therefore it is not strange that you should overlook some points which are not apparent at first sight. On page 20, Vol. 29, in reference to Solution No. 7 (Problem V), you say: 'As this solution corresponds in all essential particulars with Solution No. 3, contributed by Mr. Melancon, it is only necessary to refer to that solution to understand it.' Referring to Solution No. 3, page 18, it looks as though a part of the driving mechanism is below the ceiling, while in No. 7, and all of those shown (save No. 3), the driving mechanism is all within the specified limits.

"In comparing my solution to that of Mr. Melancon, you probably overlooked the fact that the rotary drive shown in my solution (No. 7) imparts a motion quite different from either lobed, elliptical or mutilated gears, and is capable of a wider application than lobed or elliptical gears.

"Of the solutions so far mentioned, only No. 7 gives exactly the rotary motion described at page 20 and described by the terms of the problem. In the hand sifting motion it would seem that the sieve would make a momentary stop at the instant of being caught in the operator's hands after each whirl; which closely approximates the speed variations of a cross-head driven by a crank. No. 10 is the only other solution which gives this momentary stop, but in that device the *rate* of acceleration and retardation cannot be perfectly uniform by reason of the axis of the crank traveling in a circle while the crank is revolving about its axis, and which is clearly shown by the lay-out of the crank-pin curve at page 21, Fig. 6*d*.

"In my solution the device shown gives an *absolutely uniform rate* of increase and decrease of speed from zero to maximum and from maximum to zero. This I know from experience. I recently designed and built a machine using this same drive for a very important operation where the work is quite severe, the load being variable, sometimes bringing the machine to a standstill. It is noiseless and does heavy or light work without shock or jar.

"In this case the distance between centers is fifteen inches, and the disks are steel castings two inches thick. I used but one pair of driving rollers, thus moving the slotted disks or 'Maltese Cross' one-fourth revolution to each revolution of the driving disk.

"Solution No. 2, by J. Melancon, would seem to be open to the same objections as Solution No. 6 by F. W.

Bach, inasmuch as the rotary motion would be similar to that of a mutilated gear drive. I do not say that any of the solutions published would not accomplish the desired result as far as sifting the material is concerned. The problem was not, to sift a certain kind of material, but to perform certain clearly defined movements within a given space. I believe you will admit that Solution No. 7 is the only one so far given that exactly fills the requirements of Problem V. For practical purposes I consider No. 10 the ideal design.

"Had the weight of the sieve and contents been given in the problem, it might have made a difference in some of the designs submitted. For instance, in No. 7 the driving mechanism could be much lighter, thereby making room for a cam of much larger diameter. The same remark would apply to Solution No. 5 by Wm. Whaley.

"I believe that the opinions of other contributors to this series would make interesting reading."

From Mr. Noble's point of view, his criticisms on the solutions of Problem V are pertinent. It will be recalled that in a previous article of the series I directed attention to the occasional unwarranted interpolation of terms and conditions not included in the enunciation of these problems. It will be observed that in Mr. Noble's Solution No. 7, and in his critique, I have italicized the word "rate" applied to acceleration and retardation. It cannot be found in my enunciation of the problem. While I can now see that it might have avoided possible misunderstanding to have used the word "alike" or the words "the same" as applied to the acceleration or retardation of the horizontal motion of the spindle, I submit that "uniform" means "similar" or "the same"; or, as the Century Dictionary defines the term (Definition 2),

"Of the same form or character with others; agreeing with each other; conforming to one rule or mode"; but I also confess that at the time I gave out the problem I was unduly careless of the possibility that the construction put upon the word by Mr. Noble is also technically justified when it is applied to motion in mechanics. I will therefore admit this defect in the statement of the problem. But if I had meant *"uniform rate"* I should have "so nominated it in the bond."

A word further. A uniform rate of acceleration and retardation would not have so closely imitated hand sifting as a more or less abrupt acceleration and retardation, which it was my object to produce.

Thanking Mr. Noble for his criticism, his solution and also for his compliment to my own Solution No. 10, I will now return to consideration of solutions of Problem VII, relegating some solutions of Problem VI, which have required some supplementary correspondence with their authors, to a future article.

PROBLEM VII, SOLUTION NO. 6, FIGS. 2, 2a, 2b.
C. W. PITMAN, PHILADELPHIA, PA.

Introductory to this solution, and a second solution which follows, Mr. Pitman calls attention to an error in the statement of the problem the occurrence of which I am unable to explain, as the original copy has passed out of my hands, and probably out of existence. He says:

"After working out my solutions of this problem, I re-perused the presentation of it at page 597, Vol. 28. I was struck by the statement that it was desired to produce the spiral in *bas relief;* as I could not conceive of such a result from a cutter having its axis at right angles to the plane of the spiral, without two or more operations, scarcely practical at the one setting of the work, nor under the conditions as given, I had concluded to 'give it up'.

"The two solutions given in this week's issue, Feb. 1, of the AMERICAN MACHINIST, however, suggested the thought that my stumbling block was either a slip of the pen or a compositor's error, so I concluded to join the procession.

"It is of course evident that in the solutions just published, as in those presented herewith, the cutters produced a spiral groove in the work.

"My first solution, while perhaps not giving as compact a machine as those of

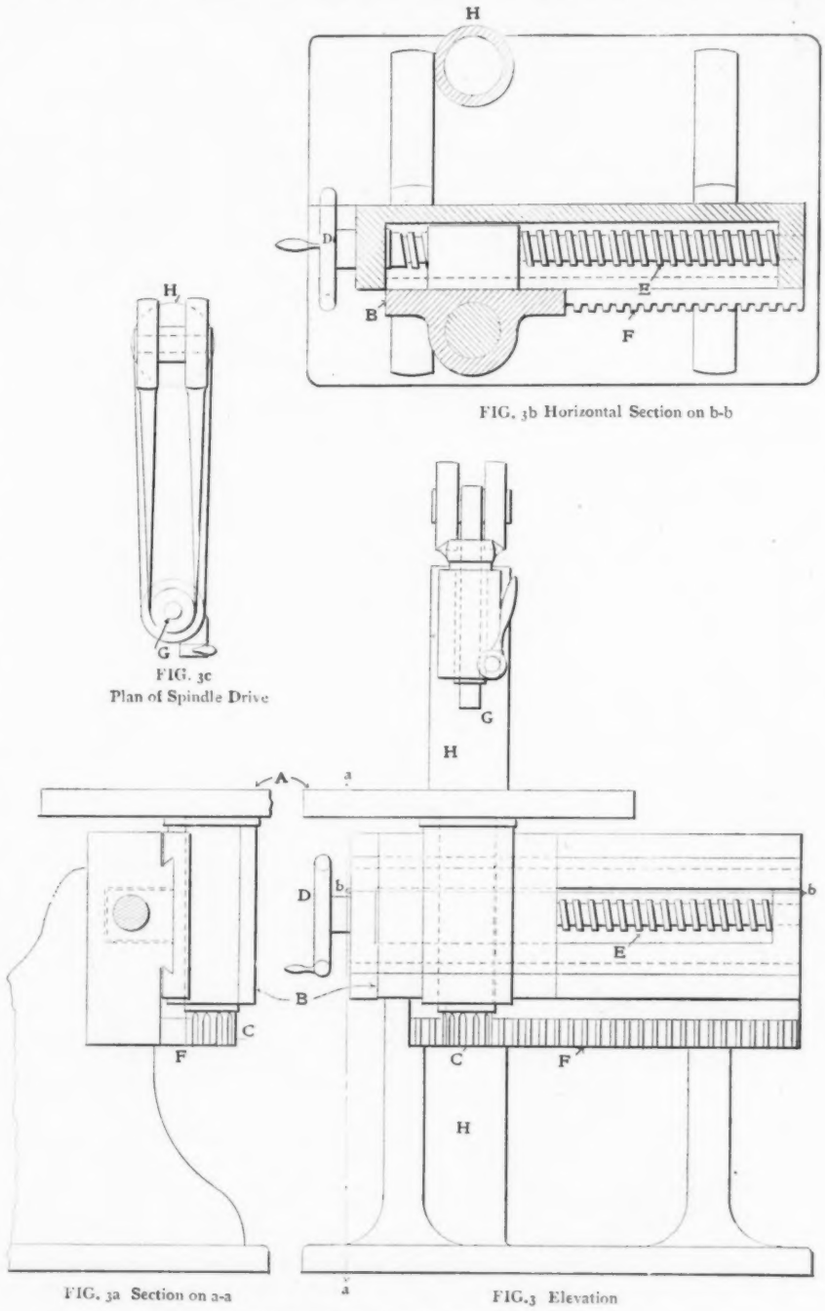


FIG. 3b Horizontal Section on b-b

FIG. 3c
Plan of Spindle Drive

FIG. 3a Section on a-a

FIG. 3 Elevation

SOLUTION NO. 7 TO PROBLEM VII.

Messrs. Whaley and Gargan, yet has some merits of its own; notably the belt drive for cutter spindle, which I think much superior to a gear drive for the high speeds and under the conditions present in wood-working tools.

"The second solution, though apparently in violation of the conditions stated in the problem, would undoubtedly have the preference as a practical machine for producing the result called for, on account of its simplicity and cheapness."

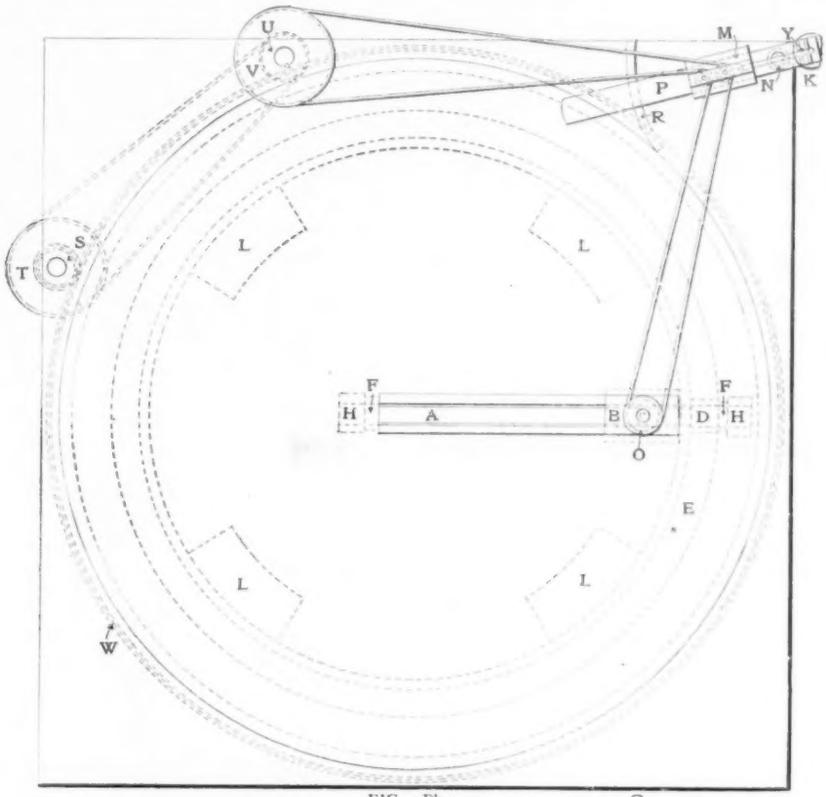


FIG. 4 Plan

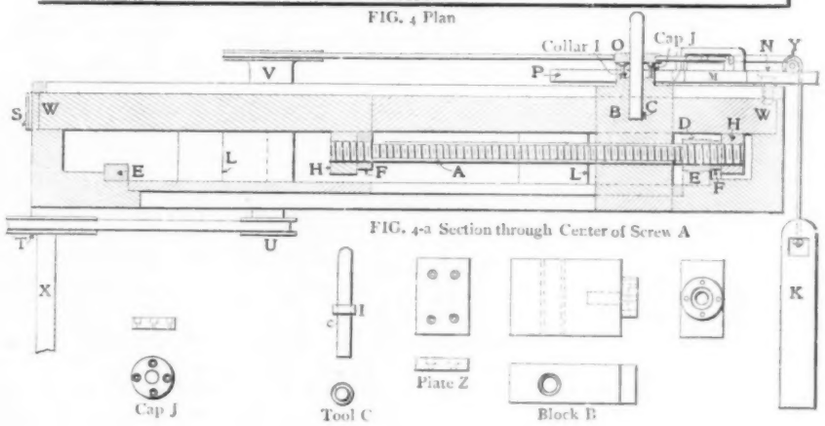


FIG. 4-a Section through Center of Screw A

FIG. 4-b Some Details

SOLUTION NO. 8 TO PROBLEM VII.

Now I will not say that I did not write *bas-relief* in my statement of the problem, and I think I must have done so, because of the customary accuracy with which proofs are read by copy in the office of the AMERICAN MACHINIST; but, if I did make this blunder, I meant *intaglio*, supposed I had so written it, always have thought of the cutting as intaglio, and never have had my attention called to the incompatibility of cutting a bas relief with the construction demanded, until Mr. Pitman kindly pointed it out. However, as a goodly number of excellent solutions have come to hand with the evident understanding that a groove, and not a ridge, was to be cut, I shall hope that no material harm has resulted, whether the lapse is chargeable to my account or not.

Referring to Figs. 2, 2a and 2b, Mr. Pitman writes:

"Fast and loose pulleys are shown at the end of shaft *A*, which is the main drive shaft of the machine. On *A* is keyed pinion *B*, engaging gear *C*, running loose on shaft *D*. This shaft is driven through clutch *E*, keyed on *D*, and sliding thereon to engage gear *C*. On *D* also is keyed a miter gear *F* meshing with *G* and so driving the central shaft *H*. Also on the end of *D* is secured gear *I* driving, through an idler, gear *J*. On the shaft with *J* and revolving with it is a bevel pinion *K* driving the bevel gear *L* secured to the hub of the circular plate *M*.

"Secured to the plate *M* and revolving with it is the casting *N*, being the guideway for the cutter-carrying slide *O*, and having within it the screw for actuating the slide; this screw receives its motion from shaft *H* through miter gears *P* and *Q*, and operates slide *O* by means of the open-and-shut nut *R*.

"For the cutter drive, bevel gear *T* is keyed to main shaft *A* and meshes with *U* on the end of sleeve *V*. This sleeve revolves freely on shaft *H*, and has its bearing in and is supported by the hub of plate *M*. On the other end of this sleeve is secured gear *W*, driving pinion *X* on the short shaft *Y*. Plate *M* is recessed to allow gears *W* and *X* to be placed below the surface. On the lower end of *Y* is a pulley belted to one on shaft *Z*; another pulley on the latter drives the cutter spindle *S*, and *a* and *b* are links connecting shafts *Y* and *Z*. *Z* and *S* are links each having a tongue fitting a guiding slot in plate *M*. A casting *d* is bolted on plate *M*, forming an outboard support for shaft *Y*, while *e* performs the same office for the cutter spindle *S*.

"The work is clamped, or otherwise chucked on a horizontal table—not shown—mounted on a slide to permit of the work being raised to the cutter, the center or starting point of the spiral being in line with the center of shaft *H*. The slide *O* should be brought to the inner end of its travel, bringing the cutter-carrying spindle *S* in line with shaft *H*—and nut *R* closed on the screw. With the machine running, the feed is started by engaging clutch *E* and gear *C*, thus revolving plate *M* and moving slide *O* outward, the combined movement causing the cutter spindle to describe the required spiral—gears *I* and *J* being properly proportioned. By changing these gears any desired pitch of spiral may be obtained; also the use of either one or two idlers between these gears will give either right- or left-hand curves.

"The machine is shown with automatic feed, clutch *E* being operated by a yoke and lever or suitable trips, not shown; but for small work shaft *D* could be operated by hand crank, either direct or geared. The frame of the machine is not shown, but sufficiently indicated by the sectioned bearings.

"Fig. 3 is a view of change gears *I* and *J*, with the swinging arm carrying intermediate gear."

This is so good a solution that I am very glad the incompatibility discovered and above pointed out by Mr. Pitman did not deter him from presenting it. I

agree with his expressed preference for a belt drive for a cutter spindle running at high speed, especially when the cutter is used for wood or soft metal.

Referring to his second solution, Mr. Pitman further says:

"My second solution does not conform strictly to the conditions of the problem as stated, as the work describes the necessary movement for developing the spiral, while the axis of the cutter spindle is fixed; but I cannot refrain from pointing out how much more easily and cheaply the end desired may be secured.

I shall present Mr. Pitman's second solution notwithstanding it does not conform strictly to the requirements of the problem. He is perfectly correct in saying that a much simpler solution is possible with a cutter spindle in a fixed position and a revolving table, than the reverse. This fact was duly considered when the problem was announced. But it was not my purpose to make the problem easy to solve. The purpose of this series has been sufficiently set forth.

Moreover, there are numerous instances wherein the spindle of a machine of this species cannot traverse a symmetrical path, or geometrical path obeying some stated geometrical law of curvature, examples of which are machines for cutting large wood types, for routing, and for general carving. In these cases the mechanical constructions require, and have required, careful design guided by just such systematic, logical thought as I perceived would be required in the effort to reach solutions to Problem VII. These problems are not framed without due consideration of the ultimate purpose of the series.

PROBLEM VII, SOLUTION NO. 7, FIGS. 3, 3*a*, 3*b*, 3*c*. C. W. PITMAN, PHILADELPHIA, PA.

"The table *A* on which the work is chucked, is secured to a shaft supported by and revolving in a bearing in the slide or carriage *B*, and having on the lower end of this shaft the pinion *C*. This slide, mounted on the machine as shown, is traversed by means of hand-wheel *D* actuating screw *E*, which engages a nut on the rear of *B;* pinion *C*, meshing with rack *F*, controls the rotation of table *A*, and therefore of the work.

"The cutter spindle *G*, which may be fed down to the work, is mounted on column *H*, and driven by belt as shown in Fig. 3*c*.

"It would not be a difficult matter to introduce a gear train between rack *F* and pinion *C*, thus permitting the use of change gears, by means of which any desired pitch of spiral either right or left, could be generated."

This solution may be studied with profit, although not conforming to the enunciation of the problem. On the principle that an incompatible solution may yet afford a good lesson, I give it place, as I have others in which rotation of the table was a feature.

PROBLEM VII, SOLUTION NO. 9. P. H. BUSHNELL, LAKEWOOD, OHIO.

Mr. Bushnell has written me a personal letter, which I quote:

"About two weeks after Problem VII was presented, I sent in a solution of it, mailed to the Editor. It evidently failed to reach *you*, and was published under 'Letters from Practical Men,' page 127, Vol. 29. I would like to have your opinion of it."

This solution was printed, as stated, under the title "An Interesting Epicyclic Train." It never came into my hands, for some reason about which I have made no inquiry. I have already above admitted the possibility of mistakes in the best families, and I may also add, in the most systematically conducted editorial rooms. I will also add that the solution justly merited the appropriate title given to it by the associate editor who prepared the manuscript for the press; and, in response to Mr. Bushnell's request, I will add also that when I read it, I deemed it a very good practical solution, which I should have been glad to have comprised in this series.*

I repeat the expression of my gratification set forth in a previous number as to the general high grade of the solutions of this problem.

PROBLEM VII, SOLUTION NO. 9, FIGS. 4, 4*a*, AND 4*b*. F. W. BACH, ILION, N. Y.

This solution is also an interesting study, and can be well understood from the description and drawings, though the latter are not quite so elaborate as some others presented, more particularly Fig. 4 which is somewhat diagrammatic. Fig 4 is a plan, Fig. 4*a* is a section at the center of the screw, and Fig. 4*b* is a group of details. Mr. Bach supplies the following description:

"*A* is a screw 1½ in. in diameter, having quadruple threads of one inch pitch or lead with a bearing at each end in the lugs *H*, which are cast integral with the top plate. The screw has two thrust collars *F* and a bevel pinion *D* of 12 pitch and 32 teeth which mesh into the teeth of the bevel gear ring *E* which is also of 12 pitch and is 48 inches in diameter, having 576 teeth. The sliding block holding the tool or cutter is tapped for this screw *A*.

"The power is transmitted to the shaft *X*, which turns the pinion *S*, which, meshing into the teeth cut in the outside edge of the top plate at *W*, causes the plate to revolve. The pinion *D* having 32 teeth and the gear 576 teeth, the pinion rotates eighteen times in one revolution of the plate. The screw having one inch pitch will cause the tool which is to start at eighteen inches from the center, to arrive at the center at one turn of the plate, causing the tool to take the required spiral path. The shaft *X*, besides driving the mechanism, also rotates the tool through the pulleys *T*, *U*, *V*, and *O*, using a flat belt from *T* to *U* and a half-inch round belt from *V* over the two idlers on slide *M* and around *O*, which is fast to the tool or cutter *C*. The round belt is kept tight by the block *M* which slides on the swinging arm *P*. This block is held back by the heavy weight *K* fastened to a rope running over pulley *Y* at the end of *P*, which swings on stud *N* and slides as it swings on the surface of *R*. To reduce friction, *P* might have a couple of rollers. *L*, *L*, *L*, *L* are connections holding the top and bottom together. The collar *I* on the tool *C*, keeps it in the block *B* when the cap *J* is screwed on. *Z* is a plate for the bottom of block *B*."

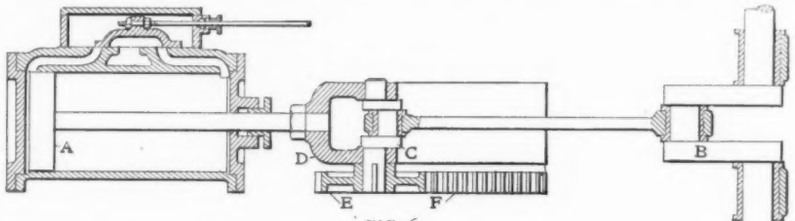


FIG. 6

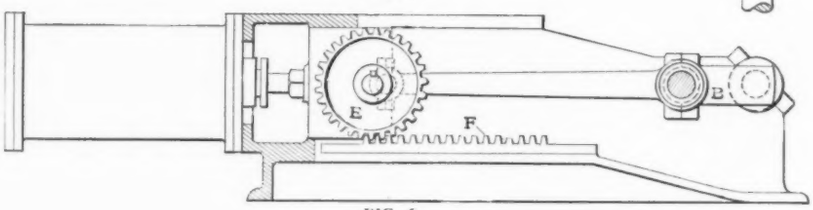


FIG 6a

SOLUTION NO. 1 TO PROBLEM VIII.

PROBLEM VII, SOLUTION NO. 9, FIGS. 5 AND 5*a*. HAROLD SMITH, BRADFORD, YORK, ENGLAND.

Introductory to his description of the device, Mr. Smith remarks that, in the

*This was sent to the editor without reference to Mr. Allen or his problems and handled by one of the staff who failed to recognize it as a solution.—Ed.

enunciation of the problem, specification of the size of the work to be operated upon was omitted. I can see no need for such specification. Mr. Smith further writes:

"I have not provided a feeding arrangement for the cutter spindle, as the work will have to be fed up to it as it is arranged; but a screw feed could easily be applied to it.

"Fig. 5 is a side view partly in section, and Fig. 5*a* an end view also partly in section, and with a few details left out for clearness. *A* is an arm from the frame of the machine. *B* is the slide on bracket for carrying the cutter spindle. It is fixed to a sleeve *C* free to revolve in the end of the arm *A*. To this sleeve is keyed the bevel wheel *D*, which is driven by the bevel pinion *W*. This is fast to a hand wheel *V* and revolves freely on stud *Z*. Stops can be arranged wherever convenient so that the slide can make only one complete revolution. *E* is a sleeve having a collar *J* fast to its upper end and a wheel *P* keyed to the lower

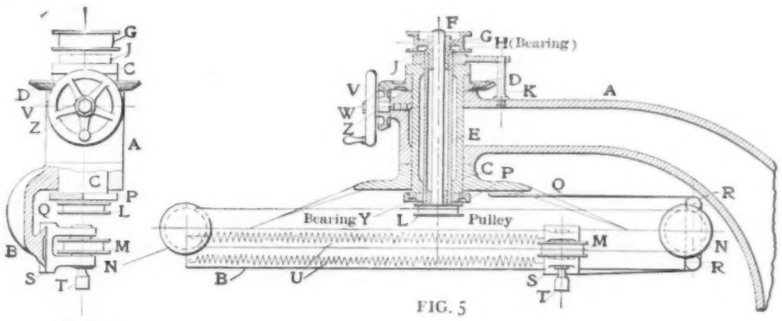


FIG. 5a

FIG. 5

SOLUTION NO. 9 TO PROBLEM VII.

end. The collar *J* has a projecting arm with a hole in the end to engage with stud *K*. This prevents the sleeve *E* and wheel *P* from revolving. *Q* is a thin steel tape the end of which is turned into a cut in the face of *P* and fixed there. It passes over guide wheels *R* and is fastened to the carriage *S*. The spring *U* keeps the steel tape tight.

"If the carriage is placed in the central position and the slide *B* given one revolution, the tape *Q* will wrap once around the wheel *P* on account of *P* being stationary. The carriage will be drawn along the slide a distance equal to the circumference of *P*. This distance will be limited by the length of the slide and also by the smallest size that it is convenient to make *P*. The tape has a quarter turn in it between *P* and *R*.

"The drive is obtained as follows:

"*G* is a pulley driven by belt and mounted on shaft *F*, which runs in bearings *H* and *Y*. On the other end of the shaft is another pulley *L*.

"A driving band takes one turn around this pulley, runs around guide pulleys *N* at the ends of slide and takes another turn around *M*, which is keyed to the cutter spindle *T*. It will be seen that moving carriage *S* along *B* will not affect the drive of the cutter spindle. I have not shown guide pulleys *R* and *N* in Fig. 5*a*.

"All the guide pulleys run on studs fixed in brackets mounted on the slide *B*. The slide bracket *B* can be stiffened with ribs, as shown in Fig. 5*a*.

"My sketches are only intended to show the principle and must not be judged by the standard of working drawings."

I shall conclude this number by the presentation of one of the numerous solutions of Problem VIII which have been received, and the announcement of a new Problem X.

PROBLEM VIII. SOLUTION NO. 1, FIGS. 6 AND 6*a*. W. ALTON, PHILADELPHIA, PA.

Fig. 6 is a sectional plan and Fig. 6*a* is a side elevation. I think this would operate as required by the problem, although it would always be a noisy affair unless run at very slow speed. I have never seen a spur-gear reversing its motion in a stationary rack, or a reciprocating rack reversing while engaged with the teeth of a spur wheel that did not thump while reversing, as there is always some back lash in this mechanism which increases with wear. Mr Alton's description explains the operation sufficiently.

"*A*" is the piston having a travel of fourteen inches. *B* is the crank having a throw of twelve inches. *D* is the crosshead of the engine. *C* is a crank, journaled in the crosshead, having two inches throw. *E* is a gear 8.91 in. pitch diameter, or 28 in. pitch circumference.

"Gear *E* is keyed on crank shaft *C* and meshes with a rack *F* bolted to the engine frame.

"Then to each stroke of the engine the crank *C* makes a half revolution in the reverse direction and takes up the extra two inches of travel of the crosshead of the engine.

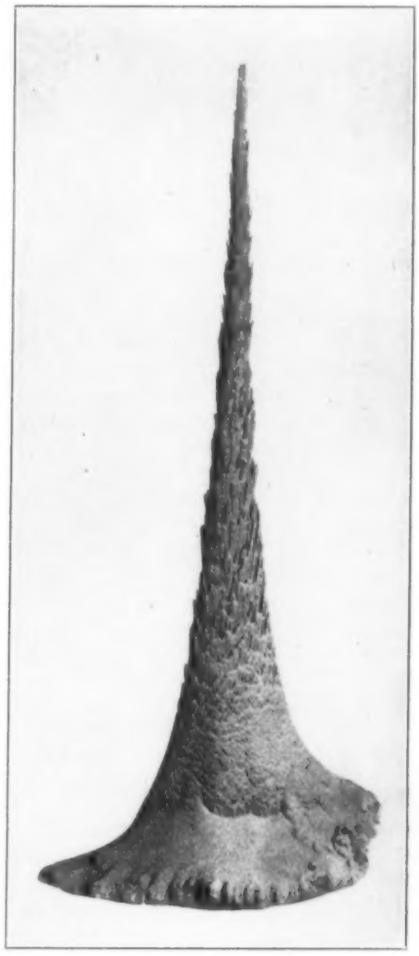
PROBLEM X.

"A shaft revolving thirty times per minute, carries a crank used to reciprocate a heavy slide. The slide weighs not less than eighteen pounds. This slide is to be moved once in a right line forward and back over a distance not less than the versed sine of an arc of thirty degrees of the crank-pin circle, during one-sixth of the time of revolution of the crank, *and only once for each revolution.* The restrictions are, that the movement of the slide must not exceed the predetermined travel which the design calls for; that no spur, bevel or friction wheels, belts, pulleys or cams may be used, and that the crank must be tightly keyed to the shaft."

A Machine-Made Stalagmite.

The stalagmite shown in the illustration was not formed in the dim twilight of the dawn of time, neither was it torn from its bed in the Mammoth Cave by a ruthless relic hunter.

Its formation is not $CaCO_3$ (carbonate of lime) but just common Fe (iron). It



A MACHINE-MADE STALAGMITE.

was formed in about two weeks, and grew in the shop of Knight & Jillson Company, steamfitters, Indianapolis. Its progenitor was a cold saw of their own design, used for cutting iron pipe and which is said to be different from all others now in use. The speed of the saw is so high that the cuttings are heated to a white heat, and weld together as they fall.

The stalagmite is 14 inches diameter at at the base and 34 inches high. It now adorns the desk of the subscription representative of the AMERICAN MACHINIST at 626 Monadnock Building, Chicago.

Letters to the Editor.

That Molding-Machine Proposition.

This is one of the most important matters facing every small manufacturer today, and one that demands his immediate attention if he expects to operate his business successfully in the future. By the use of the molding machine the output can be greatly increased, the quality of the castings much improved, the percentage of loss largely reduced and the cost of production very much lowered. Against these advantages we have the cost of the molding machine and its equipment and the risk of being obliged to change the pattern, or of its falling into disuse in a short time.

Now right here is the difficulty with most manufacturers who have had no experience with molding machines—the cost of installation, which is generally placed very much too high. The average writer on this subject is quite likely to make it appear that a pair of stripping plates for a pattern having a very irregular parting line can only be produced at great expense; this is very unfortunate reading for the man who is undecided as to the adoption of the molding machine. The facts are that where carefully and systematically handled it is really surprising to see the amount of work that can be accomplished in the way of mounting patterns on machines for a moderate outlay.

One of the first and most important matters to decide on placing a pattern on a machine is the location of the parting line. It is generally conceded that the nearer the joint of a pair of stripping plates approaches a plane surface the more easily and cheaply they can be produced, the more rapidly the molds can be taken from them and with the greater assurance of a safe lift. These facts should be well considered, as it is often a very simple matter to change the parting line without the slightest injury to the casting and very often the selection of the parting means the success or failure of the machine.

Every effort should be made to avoid deep pockets, which add so much to the cost of the plates and cause so much extra work in barring the flask and in tucking and peening to insure a good lift.

Many times we find patterns with such parts that make it seem difficult to reach the parting line with the stripping plate, and sometimes these parts are separated from the patterns and attached to slides to be drawn back by a screw or lever before the pattern is drawn. Such arrangements are often good mechanical propositions, but they are very expensive to produce, it takes time to operate them, they are likely to get out of order, and they do not appeal to the manufacturer or the molder as desirable features. The writer's attention has been drawn to several such arrangements that could have been entirely dispensed with by the addition of a moderate sized and inexpensive stop-off core that would have brought the parting line down to the general level of the plate and made an economical and safe job: the only objection to such cores is that they leave a mark on the casting, but if the core is well made and fits the print nicely the mark is very slight indeed, and in ninety-nine cases out of a hundred is not regarded as a serious fault.

At page 110 T. E. Vanderslice shows in Fig. 1 "A casting to be made," and in subsequent figures the method employed in mounting the pattern on the machine. This is a simple pattern for a machine and the description of its mounting is very clear, and while the pattern is said to be working entirely satisfactorily, still, in the writer's opinion the equipment could have been produced at less expense and the casting made a safer and quicker job.

In the first place, a pattern of this character, in the form of a hollow rectangle, having a draw of eight inches in the drag, should never be drawn downward out of the mold and the drag lifted off the stripping plate, turned over and placed on the floor. Patterns mounted in this way must have the drag well barred and consequently require about twice the work in peening and ramming to hold the sand in while lifting off and turning this part of the flask, and despite the most careful work, an occasional fall-out is inevitable. The drag pattern in this case should be mounted on a "turn-over" machine, where the drag is rammed up, the bottom board put on and swinging clamps, pivoted to the machine, adjusted to hold flask and board firmly while the machine and flask together are lifted by the trunnions fixed to the machine, turned over and placed on the floor. The clamps are then loosened and the pattern is drawn upward in the same manner as it would be in hand molding; the machine is then lifted off, turned over and is ready for another mold. By this method the drag needs no bars, therefore, costs less to make, requires less time in ramming, can be shaken out more easily and you never lose a mold by a fall-out.

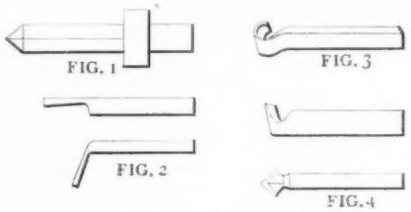
The parting line at each end of the pattern for the drag is raised 5 inches above the general level by blocking up pieces for the purpose of getting up to the center of the boss. This 5-inch raise on the drag produces a pocket 5 inches deep on the cope plate, and it would certainly be a great advantage if these pockets could be dispensed with. As the boss appears to project but about one inch and have probably a 2¾-inch core through about 2½ inches of stock, it would be a simple matter to use a stop-off or heel core, making the lower half of the boss in the core and by this means bring the parting line down to the general level and do away with the two deep pockets. In this way a considerable saving would be made in the production of the plates, the flask would be several inches shorter and the job would be enough safer to justify the slight additional expense of adding the heel or stop-off to those two cores.

NEW YORKER.

Making Wood Carrier Rolls for Textile Work.

There are used on and in connection with textile finishing machines a great number of small wood rolls about 4½ inches in diameter and from 36 to 60 inches long. These rolls, unless subjected to pressure, or working submerged in hot water or dye, are made by boring a hole about 8 inches deep into each end of a piece of 6x6-inch dry pine or poplar, of a proper diameter to make the bearing spindles drive fairly tight. These bearing spindles are made of cast brass or gray iron and resemble Fig. 1.

Rolls submerged in hot liquid and under the strains necessary to the stretch-



MAKING WOOD CARRIER ROLLS.

ing process in piece dyeing, have to be made stronger and this is done by using a one inch square shaft through the roll as a bearing spindle. In order to keep the cost within reasonable limits, many schemes were devised to cut out this square hole. The most common way and the cheapest in first cost, is to make the roll in two pieces, using two pieces of three-inch stock six inches wide and cutting out half the square in each piece on a buzz plane using a special cutter and then fastening the pieces together over the shaft with wood pins or countersunk wood screws. Extended use demonstrates the fact that rolls made in this way will allow the hot liquid to penetrate to the shaft, which will then work loose and spoil the roll.

The rig used by me for cutting these holes through the solid wood gave satisfactory results as to wear, at an average cost of 32 cents per foot of finished roll face. This includes both material and labor cost.

First a ship auger was purchased with a screw 36 inches in length and as the rolls were bored to the center and reversed this would allow an extreme length of 72 inches roll face as a limit.

The rough 6x6 lumber was cut to the varied lengths desired in lots of 50 to 100 pieces. A wooden framework was

made and bolted to the carriage of the 20-inch lathe, so that the top of this frame was 3 inches below the centers. Screwed to this frame, and lengthwise of the lathe, was a wooden stop 1½ inches high with the front edge set 3 inches back from the line of the centers. Two bolts were placed in the back slot of the carriage of a sufficient hight to allow the clamps through which they passed to just clear a 6x6 timber on the frame. Two similar bolts on the front of the carriage were used for clamping, while located under the clamps, just back of the stop on the frame were two spiral springs of sufficient strength to hold the clamps up from the timber when the nuts on the front bolts were loosened. As the rough 6x6 varied in size from 5⅞ to 6¼ inches, the hole had to be laid out on both ends from three sides of the timber. This was done by measuring the timber and finding the two sides most closely approximating 6 inches from one to the other, these were then marked with a lumber crayon for top and bottom and a straight line drawn across the ends half way between these two sides. Then one of the remaining sides was marked with the lumber crayon for the back and a line drawn across each end perpendicular to the other line and 3 inches from the side marked "back." The centers thus located were then bored by hand with a one-inch bit about an inch deep to make a place for the ship auger to start. The auger was then gripped in a chuck on the lathe and made to run approximately true. Then the latheman would slip in one of the timbers, give the front nuts a twist with an open-end wrench and with his fastest speed and coarse feed bore about half the length of the piece, then running the carriage back and loosening the nuts, he would take the timber out and reverse ends, still keeping the side marked for the back against his back stop, bore in from the other end until the holes met near the center. This way gave better satisfaction, even on short rolls, than boring the hole through at one setting. As the lathe was never stopped in changing timbers, good time was made with this rig, and the operator would soon get so he could handle them rapidly. After boring they were clamped in a vise and the ends of the hole squared the length of an ordinary wood chisel. Then a special wood chisel made from a piece of ½-inch octagon steel about 6 feet long was brought into play and the corners roughly cut out through the whole length. In the meantime one-inch square iron had been cut into lengths in the hack-saw, centered and straightened in the lathe. These were taken to the blacksmith shop and one end heated to a dull red in the forge, when they could be driven through the prepared timbers with ease. The rolls were then placed on a truck and rolled to the buzz plane, where the corners of the 6x6 were removed. They were then placed on centers in the lathe and a groove cut in the ends for the rings, using a ring tool Fig. 2. These rings are generally made from cast brass or malleable iron, but I have used scrap wrought iron pipe, 2½ inches in diameter, placed on pipe centers and a rough cut taken over it to reduce the thickness, then cut off in the hack-saw to the proper width. These are made to drive tight on the inside, with a space of perhaps 1/6 inch around the outside. This prevents cracking the roll when the ring is driven up, which may then be wedged using four iron or hard wood wedges inside each ring. The rolls are then ready to be turned and the journals finished to size. The same system of ringing and wedging is used on rolls with short bearing spindles.

Roughing cuts on the wood were made with the tool Fig. 3, while the tool Fig. 4 would finish so smooth with a light cut as to make the use of sandpaper unnecessary.

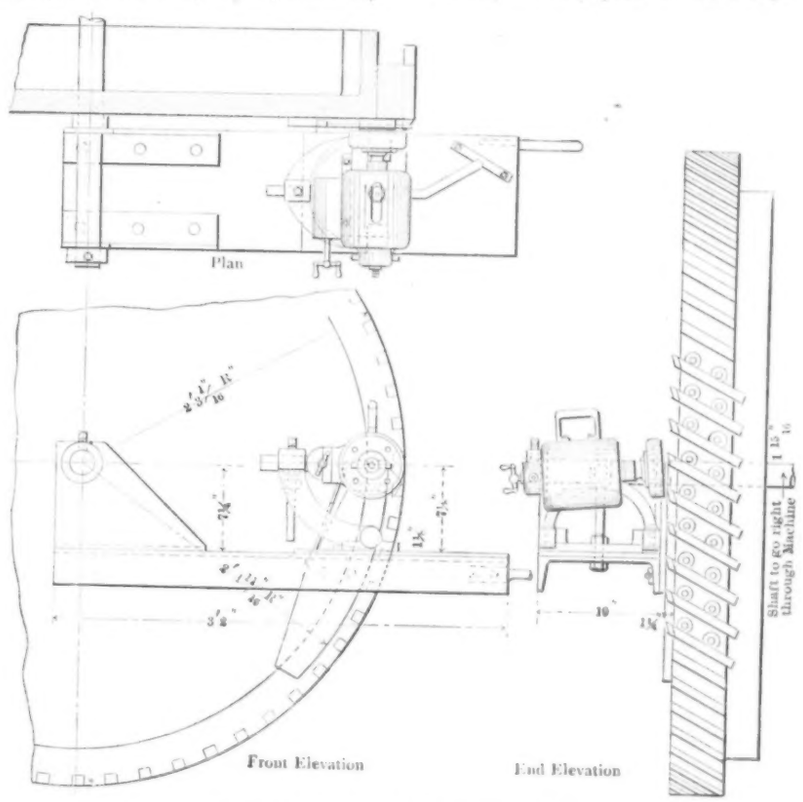
L. L. ARNOLD.

Grinding Rig for Rotary Planer Cutters.

I am inclosing a blueprint of a grinding rig for cutter heads for rotary planers, making use of a Hisey-Wolf portable grinder. We have three of these rotary planers in use with 60 tools in each. It formerly took from 3½ to 4 hours weekly to change the tools alone for grinding. We now grind the tools in place in 30 minutes and they are ground perfectly, which was not the case formerly. They are now generally run for three months without changing tools.

C. DAWSON.

Lachine Locks, Quebec.



GRINDING RIG FOR ROTARY PLANER CUTTERS.

Shop Lavatory and Meal Arrangements.

As an English toolmaker may I be permitted to reply to J. F.'s remarks on lavatory and meal arrangements in English shops? It seems to me that he has been unfortunate in his experience over here, but it is hardly fair to judge of the conditions prevailing generally on the evidence of others.

My own experience in English shops is decidedly the reverse of that of J. F. I was several years in a London shop employing 150 where excellent facilities were provided for both washing, and warming and cooking meals. Separate lavatory basins were provided and hot and cold water laid on. There were eight water-closets for two departments of about 80 hands. For cooking and eating meals a mess-room was provided fitted with a gas cooking range and long tables with chairs. A man was employed to collect all meals for warming up and also to do any plain cooking required.

At present I am employed in a North London works where the facilities for washing are very good, a long trough being installed and fitted with hot and cold water from a number of separate taps, and soap is also supplied. Six water-closets are provided for about 70 hands, and fitted with modern sanitary arrangements. Our firm has also installed a small gas boiler for making tea and coffee. A girl col-

lects tea cans at 9 and 4 and makes whatever required.

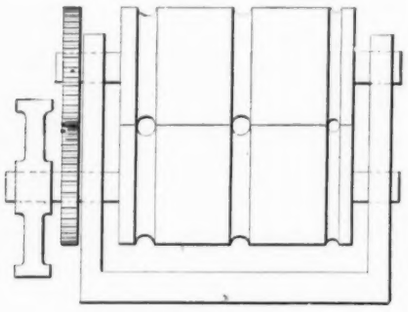
If J. F. cares to do so he can see for himself the arrangements at my present works and I extend him a cordial invitation to visit them. He will then see that modern English shops, even small ones, are certainly equal to the best in either America or Germany.

R. E. WILLIAMSON.

Wealdstone, England.

Making Solder Rolls.

I was once given the job of turning a pair of rollers like the enclosed sketch, for rolling out solder, the three different sizes being given in thousandths of an inch and very particular. My orders were to turn a gage for each size and spot and scrape to a joint. I had ideas of my own which, if I had been allowed to follow, I believe would have made a better and



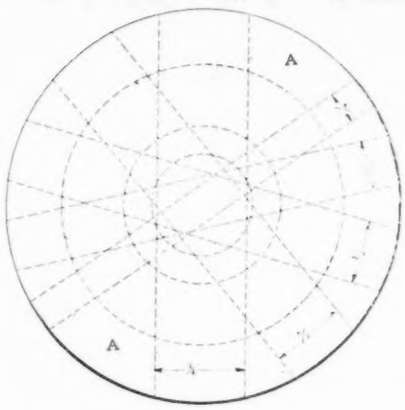
SOLDER ROLLS.

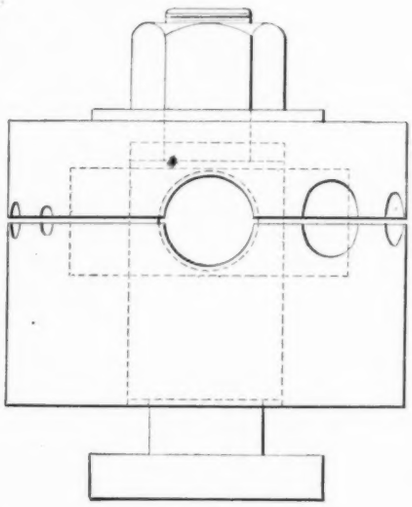
cheaper job. I wished to first finish the rolls, with the exception of the grooves, which were to be left 1/64-inch small, and set them in the frame; then to put them on the drill press, and with a reamer slightly tapered at the end, feed slowly down, at the same time turning the rolls against the feed. In this way I believed I would have had a perfect job.

FRED J. POWELL.

A Multiple Boring-Tool Holder.

Mr. Killean at page 160 has suggested a very useful tool. In my opinion there ought, however, to be a light spring between the upper and lower members, and also a steady-pin to prevent the upper and lower members from getting out of alinement when there is no boring bar in place. A further improvement would be in making the body square instead of round, as the round body shown gives too much overhang to the bars, especially so with the quarter-inch bar. The illustration shows a round-bodied multiple boring-bar holder which suggested itself to me when I read Mr. Killean's article. The boring bar goes clear through the center of the holder so that the overhang is the same for all sizes of bars, and there is no more overhang than that necessary





A MULTIPLE BORING-TOOL HOLDER.

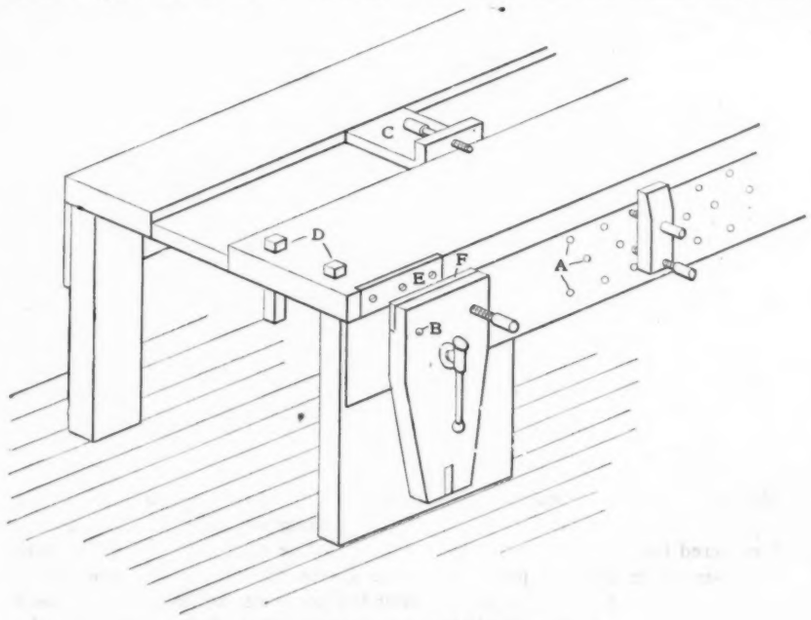
to reach the back end of the hole to be bored. At the portions marked *A A* there is room for two steady-pins and two spiral springs to keep the upper and lower members apart and in line. DIXIE.

More Kinks for Patternmakers.

Mr. Lees' article "Some Kinks for Patternmakers" at page 156 reminded me of several that I use and find very handy. Some, at least, may be new to part of your readers, especially those, who, like Mr. Lees and myself, are decided amateurs and so need all the "kinks" we can get to help us get out an evening's work.

On the same line with his hand-clamp vise, I have tapped a number of holes *A* through the side-board of my bench. When I want to joint up the edge of a long board, or dress up several pieces together, I clamp one end in the regular vise and hold the other end by the half of a hand clamp. It beats the old pin idea all to pieces. Sometimes I find that several clamps are handy. In planing the end of a board, I had trouble to hold it in one side of the vise, on account of the screw being in the middle and letting the vise board tip, until I tapped a hole *B* in the side of the vise, putting in an old hand-clamp screw, and screwing it in far enough to square up the vise. It is a splendid thing for helping to hold a tapering piece too. Two more old screws put through angle-shaped blocks *C* that fit between the two thick boards of my bench make fine stops to keep a long piece from sliding sidewise, or as a stop for a miter box, etc. They can be hung up when not in use so they do not obstruct the bench at all.

Instead of the regular metal bench stops I use two square hardwood plugs *D*, fitting tightly into holes through the end of the top board. These can be raised or lowered by a tap of the hammer to suit any thickness of board, and the plane is not injured by striking them, and the two being in line across the bench will hold a wide piece perfectly. The face of the bench and vise became badly chipped



MORE KINKS FOR PATTERNMAKERS.

off from constant use, so I just let a hardwood face *E* and *F* into both, which can be renewed at any time.

WILLIAM H. WAITE.

Cleveland.

Cutting a Cavity at the Bottom of a Hole.

In answer to your inquiry about the article at page 465, Vol 28, part 2, will say that, leaving out the matter of clearance for the chips was an oversight on my part. I hope the following will make

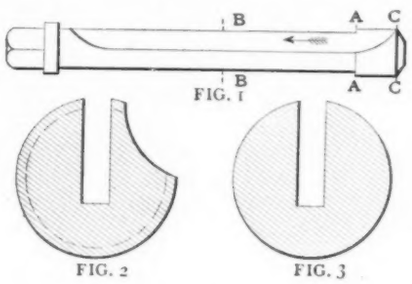


FIG. 1

FIG. 2

FIG. 3

CUTTING A CAVITY AT THE BOTTOM OF A HOLE.

it plain: Fig. 1 represents the bar with the clearance milled out. The clearance is not miled clear to the end, but stops ¼ inch from the end. The curve tends to force the chips in the direction of the arrow. Fig. 2 is an enlarged cross section at *A A* showing the full depth of the clearance, the dotted lines show a cross section at *B B*. Fig. 3 is the extreme end at *C C*.

BILL GREASER.

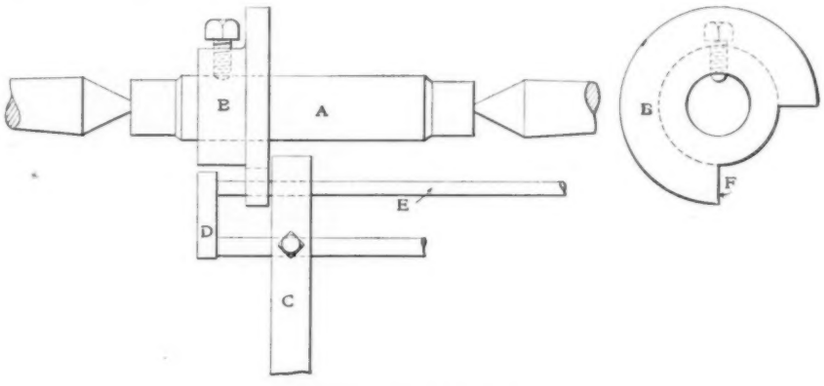
Shearing Wire in a Lathe.

Some time ago I noticed in the AMERICAN MACHINIST a shaper rigged for shearing. In the shop where I am we do this kind of work on the lathe..

The illustration shows how the job is done. The mandrel *A* is swung between centers. On it is the circular shear *B*, made of tempered tool steel. A tool-steel piece *C* is fastened in the tool post. It is drilled for the wire *E* which is to be sheared, and also for the stop *D* which determines the length of the pieces to be cut.

The action of the device is this: The lathe is started; the wire *E* is entered in the hole in *C* and pressed toward the stop *D;* when the opening in *B* is opposite the hole in *C* the wire is easily pressed up against *D*, then the cutting edge *F* of *B* shears it off. The piece *C* can have a series of holes in it to suit different sized wires. The circular shear *B* will last for a long time as there is plenty of stock for grinding.

C. W. SEILER.



SHEARING IN A LATHE.

Keeping the Hands Clean—Wearing Gloves in the Shop.

In Vol. 28, several articles were published telling how to keep the hands in better shape by the use of vaseline, sawdust and other things. These reminded me of a glove incident, and as the cold weather is here, it is as good a time as any to tell it. I began wearing gloves during a winter in a little shop where there was one big box stove to heat the outfit. In the morning the boys used to start up their lathes, etc., and make a beeline for the stove, where they remained until by craning their necks, they could see that the cut was nearly finished. At first I wore leather gloves, then leather with thin woolen underneath, and at present (when I am not repairing a Colt automatic pistol or a watch) I wear canvas, because they are the lightest, cheapest and warmest of any I ever tried. In several shops I was told I could not work with gloves on, and not being "broke" at the time I did not work. Down in a good-sized shop in Illinois I put on the gloves and asked my foreman if he objected. He said he didn't care a d——n what I wore so long as I got out the work; I of course saw to it that the work was forthcoming. One Saturday afternoon when I was getting in some overtime, along came the general foreman and having nothing particular to do at the moment, he came over and told me to take those gloves off. I saw at once that I intended to leave, so told him to send down my check and I would take the gloves off to sign it. He could hardly grasp my meaning for a few seconds, but soon found I meant it, and went off to the office to get the money. As luck would have it along came the superintendent and I spoke to him and asked his opinion about a machinist who would wear gloves. He said he thought it was O. K. on work such as I was at (rough lathe work). I then told him that my pay was coming up the line for that very thing. After getting the particulars he asked me if his general foreman had objected to the color of my shirt, or shoes or anything else. I told him that such was not the case "yet"; then he went off and I did not hear anything more about gloves, although I remained in that shop for two months after.

W. L. McL.

Canada.

Apprenticeship and Industrial Education—Attracting and Holding Desirable Apprentices.

Mr. Cardullo's article (p. 244) on apprenticeship appealed very strongly to me as it is a topic to which I have given considerable thought both as a teacher of boys and as a former employer of machinists. It does not seem to me, however, that Mr. Cardullo gets quite to the bottom of the trouble. If a position as machinist was a very desirable one there would be no keeping the boys out of the shops. Now why is it an undesirable trade? Because the pay is poor in both cash and social standing. We all get paid in these two ways. If the social standing is high it is apt to use up the cash in keeping up appearances but in the machinist's case the cash is all available for other purposes. The machinist's social standing is low because he is dirty. Now don't jump at the conclusion that I think machinists should be afraid of dirt. Not by any means. But when a machinist is working cast iron dry his clothes are only partially protected from the dust; it goes through his overalls and his other clothes and gets into his skin, and he breathes it and he swallows it. If he is working steel with oil the gum gets in so deep that no soap will wholly reach it. He goes home at night dirty and feeling dirty inside and out. And that settles his social standing even if his long hours didn't help. And after all, our machinist has to put in more brain work than in almost any other trade and use his muscles too, in lots of shops, so he gets home at night in no condition to care whether he has a social standing at all.

It is entirely possible for a man to keep pretty clean and do a good day's work for I have seen it done, but the example of his mates is no inducement, and the shop owners often stand in his way. I know of one shop right here in Worcester where they are paying at a low estimate $3000 a year extra wages, because

the shop is dirty and dark. Men don't work there if they can get a job elsewhere at 25 cents a day less. They take more notice of these things than employers are apt to believe. If shop owners and managers generally would insist on cleanliness and take care that things were so arranged that their shops could be ventilated and would insist that their help go home at night looking like men, then we might be forced to provide means of educating apprentices. Today I strongly suspect that the class of boys who would most easily make the best apprentices cannot be gotten, for two reasons: one this lack of social standing, the other that there is no promise of advancement beyond the lathe or the planer. For these higher positions are held for the graduates of the technical schools and every year the purely shop-trained man is further and further from them. If it could be so arranged that the best apprentices could be sent along into a technical school so that they all would have a hope ahead, then we might pick our apprentices from a class of bright, smart boys who today are too bright to go into the shop and are either not bright enough or are too poor to go into the technical schools. As technical schools are arranged today it is a tremendous undertaking for a boy who has been out of school three years or more to complete their courses. The boys get out of the way of learning from books, and once out of this habit it is very hard to get back into it. Their entire mental attitude has been changed and as a matter of fact very few of those who try it succeed in graduating. If these boys while they were serving their apprenticeship could also be continuing their studies even in a small way just to "keep their hand in," as it were, they would find themselves a great deal less handicapped and possibly might enter the second or third year classes instead of the first. But as things are now, and possibly for the good of the trade, we must pick our apprentices from the class of boys to whom $15 or $18 a week looks big. That means the son of the hod carrier or the ditch digger. I believe that even these boys can be handled if they are paid on the following plan. Let a definite set of jobs be planned out as suitable for an apprentice course and let a certain piece-work price be set on each. Then let a certain price, sufficient to cover cost of instruction, be set for each job. Then to the applicant for a job let us say:

"Here is a certain piece of work. We will give you all the necessary instruction for a certain price and will allow you a reasonable use of tools. We will pay you a certain price for all pieces which will pass inspection and we will charge you a certain price for all spoiled pieces. You are to stay on the job till you have paid for the spoiled pieces, if any, and for the instruction if you prefer not to pay for it in advance. Then you may stay on this job till you have earned whatever money you wish. Then we will put you through another job in the same way. When you have been through a certain course of work and have done the work so as to pass our inspection we will give you a certificate to that effect."

For a straight machine-shop proposition I think that this plan would cover the matter without a bond, for the chances of loss would be slight. The apprentice would begin to pay part of the cost of instruction while he was receiving it and the most that the shop could lose would be the cost of the spoiled work and less than the cost of instruction on a single job. There would be no inducement for a lazy or incompetent boy to stay at all, and there would be nothing to make the shop feel they were under obligations to keep him. It would automatically take care of itself. A smart boy with some funds to back him could go through flying, but lacking some of that experience that only time can give. The duller boy or the poorer boy would go more slowly but possibly more thoroughly. But in any case the boy would pay his way so far as he went. If he needs money he works on something that he has already learned how to do and if he sticks to it he ought to soon earn journeyman's wages or more. The fact that the shop equipment will be tied up longer for the same work with boys than with journeymen must be taken into consideration in making up the piece rates or if the premium system is followed it may be carried out as suggested by me in an article on page 20, Vol. 28, Part 2, on this same subject.

If this system of payment were to be applied to a trade school where instruction in other things than shop work is to be given, then it might be appropriate to charge a tuition fee large enough to cover the cost of this instruction, which would be paid in advance and serve the purpose of a bond. In cases where there was good reason to believe the apprentice to be worthy, credit might be extended to the amount of this tuition and the boy required to stay on each job until he had paid a certain amount of his indebtedness out of his earnings. This would act automatically to cull out, as Mr. Cardullo calls it, the less desirable boys but not to drive them out. Every boy would go ahead to the point where he found his limitation, but no one would be thrown out without having bettered himself. It would act like the automatic stops on the cash carriers that are so common. Each man would stop only at the point where his own lack of capacity stopped him, and the very best boys could go on into a technical school, still used to studying and so prepared that they might skip one if not two years of this course.

Worcester, Mass. E. H. Fish.

Recutting Another Stripped Nut at Sea.

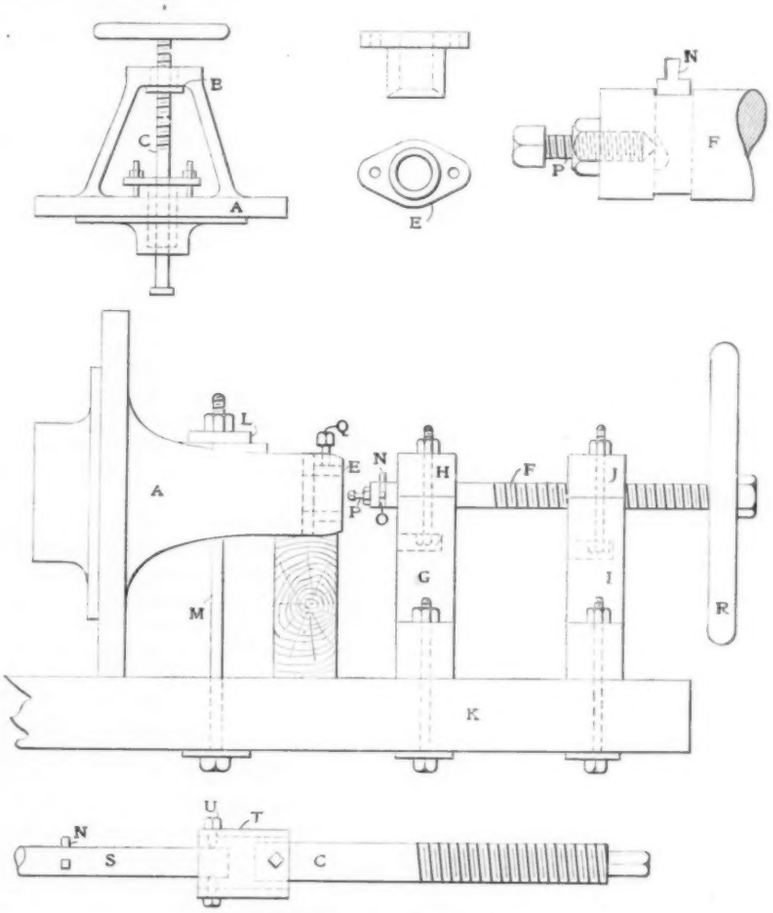
The article of J. R. M. at page 356 reminds me of a square-thread nut I cut while engineer in a British tramp steamer years ago. In those days Monaco and the adjacent Monte Carlo, of evil fame, were lighted by gas. We were lying at the coal wharf, discharging 2000 tons of gas coal. The donkey boiler situated on deck was supplying steam for the winches, so the main boiler (we had but one) was at our disposal for much-needed repairs. While packing the main stop valve I discovered accidentally that the nut *B* was nearly worn out. In the illustrations *A* shows the cap of the main stop valve with the yoke cast in one piece. The nut *B* for the screw *C* is let in from underneath and has a flange to take the thrust. It is held in place by the set-screw *Q*, shown in the lower illustration. I took the cap off the valve and knocked the nut *B* out. In the storeroom I found an old winch gland, *E*, of brass, which was a little smaller than *B*. I wrapped a strip of tin around the body and drove it into the yoke. On measuring the screw *C* I found it to be about 1¾ inch outside diameter, four square threads to the inch. The screw *C* was in new condition, having been in use only about three months. A further search in the storeroom revealed an old valve spindle, *F*, 1¼-inch diameter, the same pitch as *C*, with the thread in good condition. I decided to use this, as it would save me considerable trouble in the cutting of the new nut over what I would have if I used the spindle *C*.

I got a piece of plank, *K*, 3 inches thick by 12 inches wide and about 4 feet long. This was trued up on one side and one edge so as to facilitate setting the different members of my threading machine. The cap *A* was bolted in place as shown, care being taken to have it square and parallel with the plank *K*. An "old man" was then bolted to the plank and the nut *E* bored a little larger than the bottom diameter of the thread *C*. The wooden bearing *G* was then put in place and its cap *H* fitted. A bar with a scriber on its end was passed clear through the cap *A* and nut *E*. With this a circle was scribed on the face of *G*. After transferring the circle to the other side, the bearing was worked out with a gouge. The bearing *I* was then bolted in place, scribed and worked out in the same way, but the hole in *I* was only the size of the spindle *F* at the bottom of the thread, while that in *G* was the size of the plain part of the spindle. The thread on the spindle *F* was then roughed with a chisel so as to cut a thread in the bearing *I* and cap *J*. Both the caps *H* and *J* were put on loosely and gradually tightened down, while the screw *F* was rotated by the hand wheel *R*. After the thread was cut in *I* and *J*, the spindle *F* was taken out, the burs filed smooth and the square-threading tool fitted in the

end. The end of *F* is shown enlarged at the upper right-hand corner. The square tool *N* was held in the hole by a set-screw *O* on the side. The pointed screw *P* and the inclined face on the tool *N* regulated the depth of cut. For the first four or five cuts the tool was driven back each time at the extreme end of the cut, so as to clear the thread on the backward stroke, but after the thread was about 1/32 inch deep this was found unnecessary. The thread was a good one, but it seems to me at this late date that I have taken considerably longer to describe the job than I originally took to do it.

I suppose while I am about it I better tell you how I would have cut that square thread if I had been unable to find that other spindle *F* which suited my purpose so admirably. I would have taken the spindle *C* of the valve and a piece of round steel or iron of suitable size, *S*, say 1¼ inches or less in diameter by 18 inches long. I would have fitted up two plain bearings like *G* and spaced them a suitable distance apart. I might have put one on one side of the nut *E* and one on the other, as close as convenient for handling the threading tool. The next job would have been to make the threaded wooden journal, like *I*, to fit the spindle *C*. Then I would have taken a piece of pipe or old boiler tube and made a universal joint *T* by drilling holes clear through at right angles to each other. After threading these and fitting four pointed set-screws *U*, I would have spotted the spindle end to suit two of the screws and the round rod to suit the other two. After fitting an adjusting tool, like *N*, in the round rod and coupling the rod and spindle together with the universal joint, the rig would be ready to put in the wooden bearings to cut the thread.

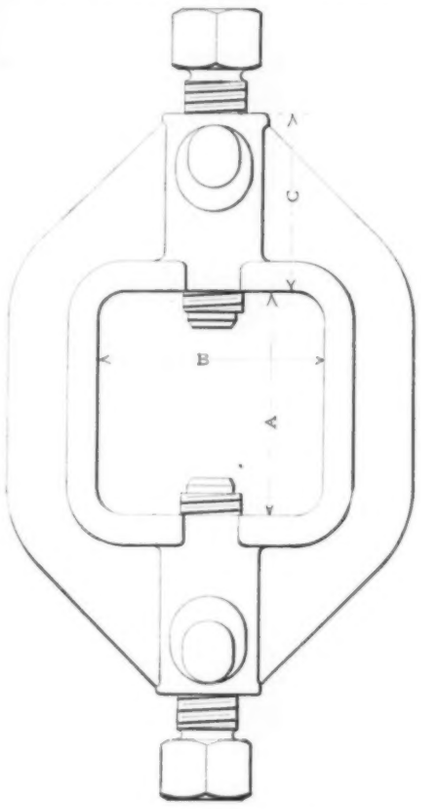
DIXIE.



HOW THE NUT WAS CUT.

A Dog with Two Tails.

It is somewhat risky to offer a criticism on anything to which Professor Sweet's name is attached, but I venture to suggest that if the dog he speaks of at page 251 had a square hole for taking the work, as shown in the sketch, it might then be provided with two set-screws without offering the "duffer" an opportunity to spoil its equalizing properties in driving. The dimension *A* might be made such as to easily admit the largest commercial size of stock the dog was intended to take, and *B* made slightly larger than *A* in order to give the dog a chance to swivel when used in its maximum capacity, and when so used, even if one set-screw was carelessly backed out so it failed to bear against the work, I think both tails of the dog would find a bearing in the face-plate slots when a moderate cut was put on, but not, of course, as readily as they would were both set-screws in contact with the work. The length of the set-screws under the head should be equal to *C* plus half the difference in diameters of the largest and smallest sizes the dog is intended to take. The dog here shown would also take square stock nearly as large as the largest round size, which might perhaps be an advantage, though of course not a very important one.



A DOG WITH TWO TAILS.

WALTER GRIBBEN.

The Apprentice Boy's Side of the Apprenticeship Question.

I have recently read with considerable interest several articles in your columns concerning apprentices. Being placed in a position where I have the best opportunity of seeing and judging from the other standpoint, that of the apprentice, I would like to say a few words for him. While the apprentice system, as at present conducted, may have its advantages, so ably discussed by several writers, it also has several disadvantages which balance, if they do not outweigh, the others. It is said that four years is none too long to serve at the machinist's trade, and that even at the end of that time, an average boy has only a general idea of the subject. A machinist's work today consists principally of lathe, drill, milling and assembling work. Filing is becoming a lost art, and if an apprentice is asked if he can chip, he will say, "That is unnecessary,

as we can use a machine to mill off the stock."

From actual experience, I have seen men taken, as it were, from the streets and broken into each and all of these branches in from two to four weeks' time, receiving at least fourteen cents an hour, while the apprentice spends four years at an average of about ten cents an hour. Something must be wrong somewhere.

It may be said that the apprentice receives more theoretical knowledge, but I have yet to hear of a shop where much theory is taught. Is it to be wondered at then that the bright, independent boy, such as is desired by the shops, hesitates to bind himself for four years at a merely nominal wage, when he can earn his living, at least, by doing the same work, but not serving his four years?

The apprentice boy today does not receive the same experience that he formerly received. All work possible is done by jigs. This is economical from the manufacturer's standpoint, but unfortunate for the apprentice. A single case will suffice. An apprentice of at least average ability served four weeks on the drill presses. During that time he had two days' work at laying out; the remainder was jig work on job work. How much did that apprentice learn about drilling?

Forging was formerly considered part of the machinist's trade; a man was always expected to forge his own tools. This same apprentice had two hours and a half in the blacksmith's shop, and during that time he and two others each forged and hardened a tool under the smith's directions. That is all the blacksmith work he will get.

Manufacturers will say that during the first year they lose money on apprentices. How can this be when the apprentices do exactly the same work as the regular lathe hands who receive twice as much?

Overtime is another sore point. If apprentices are expected to work overtime they should be paid at a good rate and be allowed double time on the time they gain. Is it any wonder that good boys are so hard to find among apprenticed machinists and that most of them are discontented?

Shorter time to serve and larger pay would improve the system very much, and there also should be some method by which the manufacturers can be brought into closer touch with the boys, and not govern them through hired employees.

APPRENTICE.

Setting Cams.

In placing cams on a shaft I have found the following a very easy and sure method: A 1/16-inch hole is drilled through the set-screw lengthwise, and the screw hardened. The cams are all fitted with set-screws of this style, and clamped in position on shaft. Using a breast drill, I drill into the shaft through the screw simply to spot it, remove the cam and drill the shaft, using a combination center drill. The pointed screws are placed in position and the camming is done.

S. W. GREEN.

Best Modern Practice.

What is "best modern practice"? and how are we to recognize it when we see it? These questions were raised in my mind some time ago when I witnessed an argument between two men, of whom the loser closed the matter by saying: "If you will look up the best modern practice you will find what I say to be true." I found afterward that what this particular man meant by best modern practice was Brown & Sharpe practice, but in this case he was applying it to something a long way out of their line. I suspect that if the management of Brown & Sharpe were situated differently they would do differently, that is, I suspect that their practice as a general thing would be extremely elastic. I also suspect that the practice of the oil well country, about which Mr. Osborne tells us, is just as much the best modern practice as that of any modern shop in the East. Chordal told us years ago that it was spoiling work to finish a roll for a sugar mill as finely as one for a calender. What is best in one place would be the worst in another. What may be best practice for an old concern with established reputation and a big bank account, may be suicide for a new concern just starting with a lack of capital.

To be sure, along certain lines of practice, design has settled down so that, for instance, it is hard to tell two makes of electric motors apart without seeing the name plates; but because a point of stagnation has been reached in this line is no more an indication that we have reached a point of finality than the stoppage of growth of a tree in the winter; and it is surely no indication that there is, or will be, a certain design of planer or suspension bridge or tack machine that is the "best modern practice." Then there are cases like one that has come to my notice. About 30 years ago an ingenious mechanic in Worcester put a worm gear on a lathe apron meshing with the lead screw, and by a dial on it was able to throw in the half-nuts at the right moment to catch the thread. Four or five years ago I noticed that a patent had just been issued on this same thing, and now I notice that it is being extensively used in Cincinnati. What 30 years ago was a freak is now at least "good" modern practice.

Then who is to say what is the best practice of today? The men who are in it, who are sufficiently interested in any one branch to be capable of judging, are rendered incompetent by the fact of their prejudice. I never saw anyone who was posted at all who gave a moment's consideration to the medals and diplomas at the fairs. Those issued at St. Louis are as thick as mosquitos in New Jersey, and they all read to impress one that they are all first prizes at least.

Points of design that have once been standardized, like the diametral pitch system of gears and the Sellers system of bolts and nuts, are only challenges for someone else to do differently, and every little while we are invited to cut off the tops of the teeth of gears or make the threads finer. After looking the ground all over we have to conclude that the "best modern practice" must be made by each designer as he goes along, and that it will vary from time to time with each designer if he is progressive. And we conclude that the only excuse for a standard that we can refer to as " best modern practice" is that it is a convenience for the manufacturer and can only refer to minor details which engineers can hardly afford to spend time to change for individual situations. In one way it is fortunate that this is so, for if we could reduce all matters of engineering practice to rule, then any man with a book of rules in his pocket and a good index to it could be an engineer, and wages in the profession would be about $15 per.

ENTROPY.

Faulty Drawings Furnished by Machinery Builders.

The managers of most modern manufacturing plants concede the utility of a drawing-room force as a factor in economical production, but many of them seem to regard drawings sent out for the information of their customers as something which bring them no return and should, consequently, have their cost reduced by every possible means, even though the result is something very nearly useless for the purpose for which they are issued.

Drawings submitted by the builders of steam pumps and similar machinery are generally such meager outlines as to be anything but satisfactory to the recipients, Seldom, is the clearance required for removing pistons or plungers given; often there are no direct dimensions from the face of outlets to the centers of anchor bolts; and almost invariably there is no plan, merely a ghostly outline of one end and a side elevation, and these so incomplete that it is impossible to construct a plan view from them.

The first thing an engineer requires in laying out work is a plan view, and this is the very thing the builders rarely furnish unless by special request. Elevations, though always desirable and generally essential, are frequently not required until considerable progress has been made in arranging the machinery in plan view. The matter of next importance is the absolute clearance required, and this usually necessitates a letter to the factory, with corresponding loss of time. More-

over, it sometimes happens that the need of clearance for removing parts is overlooked, with consequent trouble when the apparatus is required to be overhauled or repaired.

Many boiler manufacturers are entitled to a front rank among offenders of this class. They will furnish a proposal accompanied by drawings which, sketchy and incomplete as they are, have been made for some former purchaser and represent only approximately the proportions of what they expect to furnish. They show piping and connections and leave it an open question as to whether they are to be supplied by the builders or not, and when the contract is signed and a final drawing received it frequently fails to give the size and exact locations of steam nozzles, feed-water and blow-off connections, and if any fittings or castings are to be furnished by the purchaser, to so state the fact and give the data necessary for their construction.

All this reacts against the reputation of manufacturers who furnish such faulty drawings and in favor of those among their competitors who know enough to do better. The reputation which a firm holds among draftsmen and engineers is steadily becoming a more important factor in its business success, and there is no other small item which will do as much to impress an engineer favorably as the receipt of properly made drawings of the machinery which he is called upon to install. GERALD E. FLANAGAN.

Improving the Drill Spindle.

When using the drill press for operating on the underside of pipe flanges, etc., which require facing about the bolt holes, and which cannot be machined in the usual way we use a cutter bar with left-hand cutter for the facing operation, the bar being held up in the spindle against the downward pull of the cut by a taper pin put through spindle and bar. This of course is a very simple expedient and one often resorted to and I cannot see why drill makers in general do not bore this taper hole in the spindle and thus make provision for undercutting, before the drill spindle is fixed in position; it is certainly no disadvantage to have this hole in as far as I can see, yet I have never seen a new machine provided with it. The taper pin is much preferable to a set-screw which keeps stripping and spoils shanks, etc., whereas when the pin is knocked out there is no obstruction.

We recently received two new radial drills from one of the leading American makers, and had to take the spindles out the first week to perform this operation before we could do any undercutting with them; this job could have been done much more quickly by the makers.

England. SHELL.

Legal Notes.

BY E. P. BUFFET.

IS IT NEGLIGENT TO USE SEMI-ANNEALED STEEL IN PRESS-WORK?

A man was working for a cutlery company, cutting knife blades in a press with a punch and a die; a fragment flew, putting his eye out. He had been doing such work for the company for about three years and a half, and until the day before the accident occurred he had been using annealed sheet steel, but it appeared that at the time of the disaster he was using what is commonly called "floor-annealed" or "semi-annealed" steel. The evidence was conflicting, but the jury determined that the company had not bought this steel as annealed steel, and that its employment constituted negligence on the part of that concern. The Massachusetts Supreme Court, on appeal, allowed the verdict to stand.

A question arose in this case whether the injured workman has assumed the risk. There was evidence to show that after a flash and unusual noise, as the punch struck the steel the day before the accident, he went to the manager and had a talk with him about it. "Here," said he of a piece of steel, "is a place so hard I cannot file it. The file won't touch it" The manager replied, "Why, that is curious; if we should order steel like that, they could not make it for us." The workman told him that he had never seen anything like it before, and the manager said, "No, and you probably never will again." The court regards this as sufficient to permit the jury to find that the workman relied on the manager's statement as to the non-recurrence of the trouble, and thus avoided assuming the risk on his own responsibility.

This case may be of importance to manufacturers of stamped metal as tending to show that they may incur liability by using steel not fully annealed unless the workman knowingly assume the risk. At the same time it must be noted that apparently the negligence in employing it has not been established by a judge as a matter of law, but is the finding of a jury, the appeal court merely holding that the evidence sufficed to place the matter within the scope of the jury.

76 N. E. Rep., 194.

EFFECT OF VIOLATING A STATUTE ON EMPLOYER'S COMMON LAW LIABILITY.

When a statute renders it obligatory for the operator of a factory to adopt safeguards for his machinery, imposes perhaps a penalty for his failure to do so, the question arises whether his liability to an injured workman on general Common Law principles is thereby affected. Thus, it is a point on which courts do not wholly agree, whether the fact of his having violated such a statute precludes him, in a civil action for damages, from setting up as he might otherwise have been in a position to do, such a defense as that the workman "assumed the risk." In a recent case growing out of a factory elevator accident, which is somewhat relevant to this point, Judge Bradley, of the Supreme Court, says: "While the violation of a statute or ordinance by a defendant is not conclusive proof of his negligence on the part of the violator, it has been held that the fact of violation may be considered by the jury in passing on the question."

76 N. E. Rep., 192.

NEGLIGENCE IN DETAILS OF WORK.

It is well known that in deciding whether the act is that of a vice-principal, so as to render an employer liable for damages to a workman injured by it, or is that of a co-employee, for whose conduct the employer is not responsible, if he had good ground to believe this co-employee a safe one, more regard is paid to the nature of that act than to the nominal grade of the man doing it. A recent case in New York State illustrates an act which is regarded, at least under the circumstances thereof, as a mere detail of the work for which the employer would not be liable. This was putting on a belt without taking the precaution (which the company claims to have prescribed) of shutting down the machinery. A case cited by the court as a precedent was one in which a person in control had suddenly turned on steam and started machinery. We must not infer, however, that there are not many conditions under which an employer would be liable for damages resulting from the unexpected starting of machinery.

75 N. E. Rep., 933.

DUTY OF GIVING WARNING OF APPROACH OF CRANE IN EXCEPTIONALLY DANGEROUS PLACE.

The Appellate (not the highest) Court of Indiana has sustained judgment in favor of a man who, according to the allegation, was crushed, mangled, mutilated, bruised, lacerated, etc., by a traveling crane which struck him while he was fastening cleats for electric wires to a pillar of a steel mill. A discussion of the circumstances of the case tended to show that he was not himself negligent, and that the company should have given him warning of the approach of the crane. This came under the rule by which an employer is required to furnish a safe place in which to work, and whether or not the duty of giving warning of the danger had been delegated to another employee who failed to give warning, the employer was not relieved of responsibility for its not being given.

75 N. E. Rep., 852.

The American Society of Civil Engineers has admitted a woman to membership in one of its lower grades, which is a new departure.

Mallable Cast Iron.

BY CHARLES H. DAY.

The process of decarbonizing iron in order to give it malleability has been known for about two hundred years. It was first described by Reaumur, the distinguished French metallurgist and philosopher, in 1722. From that time until in 1804, when patents were issued to Samuel Lucas, of Sheffield, England, the process of making malleable iron was more of a theoretical than a practical method. At the shops of Samuel Lucas the process was worked out, but not as we have it now. As the letters of the patent describe it, it was a method of separating impurities from crude or cast iron and making it malleable without fusing or melting it. The iron was made malleable before it was cast instead, as is now the case, of being annealed after casting. This method was afterward abandoned, and, although the largest malleable foundry of the time was owned by Samuel Lucas and his brother at Sheffield, there were many competitors.

From England the industry spread to this country, and it is its development here in which we are most interested. The first malleable iron castings in this country were produced in Newark, New Jersey, in 1826. Seth Boyden, to whom this honor belongs, was born in Foxboro, Massachusetts, in 1778, but moved to Newark in 1815. His youth was spent in farming and occasionally at his uncle's forge. His schooling didn't amount to much, but mechanical ingenuity and skill with tools all came to him naturally. This led him to a variety of work, and credit is given him for inventions in almost every line of science. But his best and certainly, from a commercial standpoint, most important work was done in bringing to perfection the ideas of others.

THE WORK OF SETH BOYDEN.

Soon after coming to Newark Boyden was engaged in a silver-plating business. The speciality of the company was silver plated harness goods, which in those days were very expensive since they had to be made by hand-forging wrought iron. He knew of malleable iron manufacture in England and it was probably its adaptability to this line of use that led him first to experiment in its manufacture. At this time the process of annealing was kept secret at Sheffield and Boyden had to practically re-discover it.

In 1828, the Franklin Institute of Philadelphia offered a silver medal for the best specimen of annealed cast iron, to consist of at least twelve pieces The committee's report says: "Premium No. 4, for the best specimen of annealed cast iron, is awarded to Seth Boyden, of Newark, N. J., for specimen No. 163, being an assortment of buckles, bits, and other castings, remarkable for their smoothness and malleability. This is the first attempt in this country to anneal cast iron for general purposes that has come under the knowledge of your committee, and success attending it, fully entitles the maker to a silver medal." From the wording of the report it is clearly shown that his work was not regarded as an invention but as the first in this country.

Boyden's experiments were carried on over a period of six years or more in order to find the best pig iron to use, the best packing, proper temperature for annealing, etc. The results of these experiments were that he used what was called Sterling iron for his castings and lime for his flux, while the fuel used was first dry pine wood, and later, soft Virginia coal. His practice seems to have been to run the iron to a very high temperature in an air furnace of about 1000

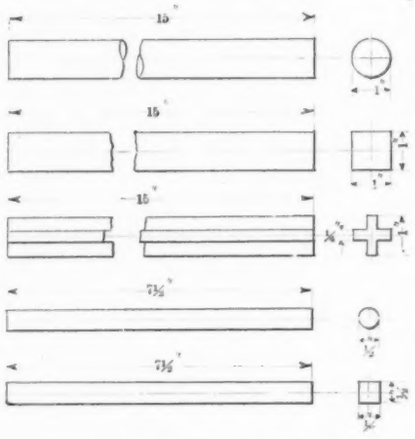


FIG. I. COMPRESSION TEST PIECES.

pounds capacity. Starting at 3 a.m., eight heats a day were taken, often not finishing until late at night. The furnace was not tapped but the iron was dipped out in clay-washed ladles, holding from ten to twelve pounds each.

The first cupola was built in 1832 and used hard coal. This cupola was of the solid-bottom type, and consisted of a straight shaft, the upper part of which could be lifted off to allow cleaning and repairs after a heat. The probable reason for this design was the small size of the cupola, which was only 18 inches in diameter. The pig and fuel were charged in at the top or through a door near the top. Such a cupola could only be operated every other day as the cinders and unmelted stock required time to cool so that they might be taken out and repairs made. The use of cupolas and air furnaces for melting malleable iron was up to a recent date a practice in this country only, in foreign plants crucibles still being used.

The first annealing furnace was shaped like a bee-hive and the pots were inserted from the top, which could be removed by a crane Mill scale was packed around the pots and the whole was kept at annealing temperature for a week. This type was succeeded by a rectangular furnace, which was run day in and day out. The floor was on an incline and the pots were started at the higher end and shoved through and out at the lower end; hence it was called a "shoving furnace." Pine wood, charcoal, or soft coal was used for fuel.

A great variety of castings were made. A list of those which was published by Boyden includes over a thousand articles. Anything in fact from machinist's tools to cutlery and even surgical instruments were cast at his foundry. At first the prices obtained ran as high as 25c. per pound, but they fell rapidly until 8c. was a standard price. After the Civil War, however, the price rose a little.

GROWTH OF THE INDUSTRY.

The extension of the malleable-iron industry was very rapid, and plants were started in many cities of the North and East at about the same time. Among these were the New Jersey Malleable Iron Works, of Newark; The Oak Hill Malleable Iron Company, at Oak Hill, N. Y.; Stellwagen & Bryant, of Philadelphia, and Alexander Boyden, at East Boston. All the above-mentioned firms and many others were started between the years of 1833 and 1850, but many of them were short-lived.

Many changes in the manufacture were tried but not until after the Civil War was there any radical change made in the malleable-iron production.

With the growth of the country the malleable-iron business has gradually extended and foundry appliances have been enlarged and improved. The pig iron was obtained from furnaces all along the Atlantic up to 1862. About this time, however, much trouble was experienced on account of the blast-furnace practice then coming into use in the manufacture of pig iron. This made a higher silicon iron and, in many cases, an iron unfit for malleable castings. As technical chemistry was then an unknown science, there was no sure means of knowing whether the iron ordered would be suitable or not. Much money was lost in this way and it led to research into the combination of pig iron for its different future uses.

With the outbreak of the Civil War there arose a great demand for iron for the use of the United States Government and the furnaces which had supplied the malleable foundries were used in that work. At this time, luckily, the Lake Superior iron was brought into use and proved to be very well suited for malleable work. Its use rapidly extended and it is still the source of a great deal of the pig iron used in malleable castings.

From the time of the war on, a great many changes have been made in the casting of malleable iron and also in the annealing. This has been helped to a certain extent by the increase in the knowledge of analytical methods in combining the pig iron to give the best results. But in the melting and pouring there have been remarkably few changes made. The capacities of the furnaces have been increased and the handling of the iron by mechanical means has of course done away with a great deal of the expense. The open-hearth furnace has also come into use and is considered today more economical than the cupola. Especially is the economy noticeable in large castings as a more uniform iron can be obtained.

Another important step has been in the use of oil burners both in melting the iron and in the annealing ovens. This is done not so much from the standpoint of expense as from the standpoint of cleanliness and controllability, and, in the case of the melting, it does away with the sulphur which is always present to some extent in the coal. Even today the practice in malleable-iron foundries is not an exact science and the mixing depends mostly on the superintendents for its success. Experiments have been made until the right per cent. of ingredients in the iron is known for different sized castings and it rests with the superintendent as to how close to this to come.

EXTENT OF THE INDUSTRY.

The malleable-iron industry is much more highly developed in this country than in any other part of the world, although there are some very large foundries in England, France, and Germany. Especially have the Americans surpassed others in the variety of labor-saving devices in the handling of castings.

There are today in this country about 125 malleable-iron foundries. These produce about 2000 tons per day or 700,000 tons per year, while the output of all the countries of the Old World is only about 80,000 tons per year. Of the foundries in the United States there are only two below the Ohio river and none, I believe, west of the Mississippi. Those along the Atlantic make most of the small castings while the larger ones are cast in the middle West.

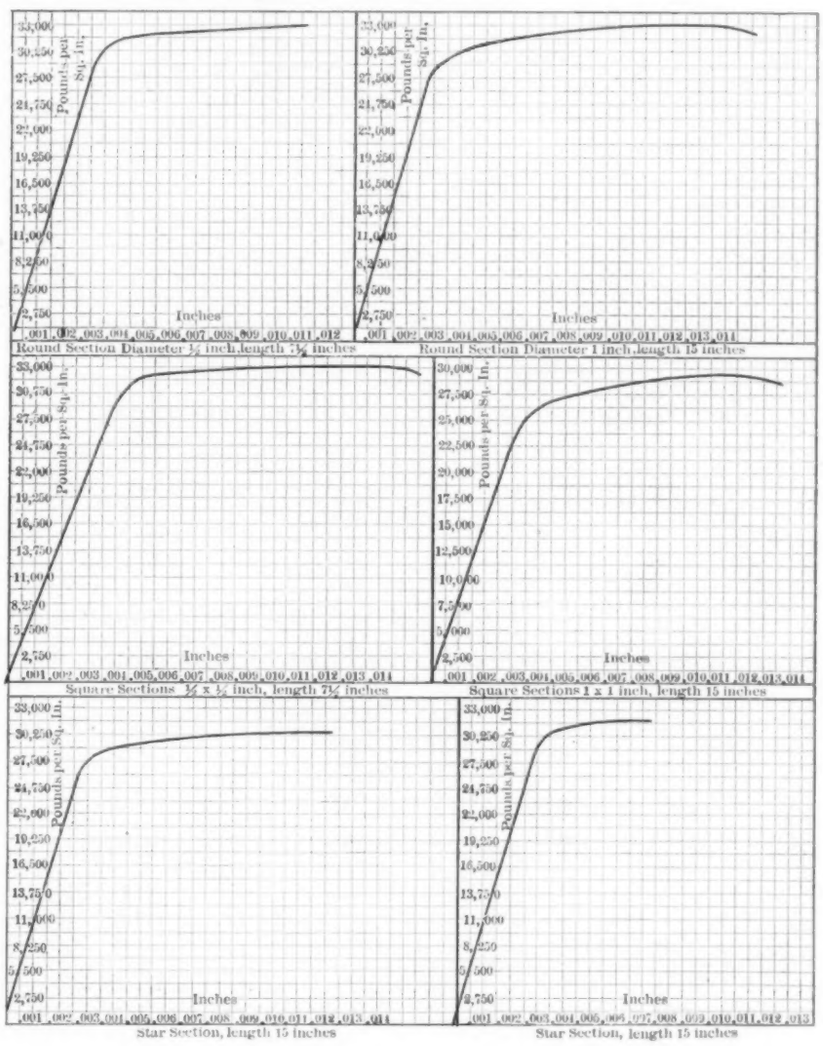

Pounds per Sq. In.
Inches
Round Section Diameter ½ inch, length 7½ inches
Round Section Diameter 1 inch, length 15 inches
Square Sections ½ x ½ inch, length 7½ inches
Square Sections 1 x 1 inch, length 15 inches
Star Section, length 15 inches
Star Section, length 15 inches

FIG. 2. COMPRESSION TESTS OF MALLEABLE CAST IRON.

Malleable iron is sold so low now that it has, to a considerable extent, replaced the gray-iron castings. It was thought at one time that one of the steel-casting processes, such as the open-hearth, modified bessemer, or any of the other numerous semi-steels, would replace malleable iron. In the heavy castings this has proved true but in the small classes of work the difficulty of preparing small molds to withstand the high temperatures of steel and the cost of the plant have prevented its use. Thus each is being developed along its own lines.

There are four great classes of work for whose requirements malleable iron is especially adapted. These are agricultural implements, railway supplies, carriage and harness castings and pipe fittings. Besides these main classes of work for which malleable iron is used there are innumerable other unclassified uses to which it is put.

PROCESS OF MANUFACTURE.

Malleable iron is now principally made from charcoal pig iron, to which is added a percentage of scrap and sprue sufficient to use the culled work, gates, runners, and shrinkers resulting from the continued application of the process. When coke pig iron can be found, which has been made out of a good quality of coke, it is also used.

There are two principal kinds of furnaces used; the cupola and the open-hearth. The cupola is the cheapest and really the best for the lighter patterns, when a uniformly superior metal is not required. The open-hearth furnaces are much better for heavy work, and a much superior uniformity can be obtained by them. There are in the United States only ten foundries which use the open-hearth furnaces. To run them economically they must be run continuously and have a skilled workman to run the mixer well. By means of the open-hearth furnace the iron is not only melted but refined. The usual limits of these furnaces are from 15 to 20 tons at a heat. They will run 300 heats without repairing, and 1000 heats before rebuilding. Still the cupola iron does the majority of the business, though it is considered inferior and require 200 degrees F. more to anneal than the open-hearth iron.

There are two kinds of fuel in general use for the furnace; a hard, close grained coal requiring a straight forced draft with an air pressure of about 4 to 5 oz., or a Siemens-Martin furnace using fuel oil. Since sulphur is undesirable and is always contained, to some extent, in the hard coal, and not in the oil, it gives the oil an advantage. It is easier to regulate the oil burners, but the expense is slightly greater. The regulation is, too, a great advantage, for if the heat is run too high in the furnace it will burn the iron, especially if it is low in silicon. This does not show in the casting but gives it a high tensile strength without elongation.

This is due to the interior arrangement of the molecules.

After the castings have been chipped and sorted they are packed in iron annealing pots, holding about 800 pounds of iron. They are packed into these pots together with a packing of clean, heavy forge scales. Great care must be taken in the packing in order to avoid distortion during annealing, and the pots must be packed full. A sprinkling of powdered quicklime, sal ammoniac, muriatic acid, or any oxidizing agent is then put on to the packing to assist in the annealing and also in dumping the pots afterward. The fuel used in annealing is in most cases coal. However, many of the modern foundries use oil or gas burners. These latter are generally considered better, not so much on account of the expense, but because they are cleaner and permit better regulation. Good iron can easily be spoiled in the annealing ovens unless the greatest heat is brought out at just the right time. This is very hard to do with coal ovens and requires a great deal of experience. An experienced man can tell whether the heat is right or not by the color of the inside of the oven.

The time necessary for annealing varies with the mixture of the iron more than with the size of the castings, and is from 3 to 10 days, including the time necessary to cool the pots. In the first 36 hours the oven is brought up to the maximum heat of about 1250 or, better, 1350 degrees F. At this temperature it is kept for two days, when it is allowed to cool slowly until it reaches a black heat, at which time the pots are taken from the oven. In the space above the pots in the oven the temperature runs some 200 degrees above the values given. After annealing the castings are sometimes dipped into asphaltum diluted with benzine to give them a better finish. The cost of annealing is 0.25c. per pound in a 30-pound oven with two oil burners. Using coal as a fuel the cost is somewhat less.

After the castings have been annealed they are unpacked, collected, and taken either to the tumblers or the sand blast. The tumblers are the cheapest method of cleaning, but the sand blast has come into use as it is much quicker. When cleaned, the castings are ready for shipment, and may be drop-forged or even welded when the iron has been made for that purpose.

COMPOSITION OF THE IRON USED.

The process of malleableizing iron is one that not only affects the chemical properties of the iron but also its physical properties. The pig iron to begin with must have a certain chemical composition. The principal things to look out for are the carbon, silicon, and sulphur. Then of smaller importance are the manganese and phosphorus. Values for these elements, of course, vary but the following are taken from good practice. The carbon can vary from 2.75 to 4.25 per cent. The sulphur must be kept below .05 or better below .04 per cent. The manganese does no harm unless it runs over .4 per cent. but above that it causes trouble in the annealing. The phosphorus should be kept less than .225 per cent. The silicon, which is the most important factor, has a very wide range and depends on the kind of work the iron is to be used for. The thicker the casting the lower the per cent. of silicon allowable in order to get white iron in the sand. For the heaviest work the silicon should be as low as .45 per cent., for ordinary work about .65 per cent., for the best agricultural work as high as .8 per cent., while in the lightest work it may run up to 1.25 per cent., which is the highest limit for silicon in any good malleable casting. The values here given are not binding and many different opinions are expressed on the per cent. of these elements. Some men allow sulphur as high as .7 per cent. and phosphorus up to .25 per cent. but these two elements tend to weaken the casting by causing small cracks all over the surface.

In order to be strong and malleable the un-annealed casting must have no graphitic carbon but the total carbon must all be in the combined state. If a given molten iron at a given temperature be poured into a mold of a certain size and shape, the casting will contain all its carbon in the combined state. If the casting be smaller, with the other conditions the same, the carbon will still be in the combined state but there will be a surface chill. If, however, the casting is larger the iron will have longer to cool and the combined carbon will change into the graphitic state, and will show in the fracture as black spots the size of pin heads.

The annealing process tends to expel the carbon from the state of combination and deposit it between the crystals of the iron. It does not deposit it in the crystalline graphitic state as it appears in gray iron, but as an amorphous form of carbon not unlike lampblack. Then the carbon is removed from the skin by oxidation, thus forming the white skin seen in the fracture. This is the American practice, while in Europe almost all the carbon is extracted. The shrinkage in un-annealed castings, when all the carbon is in the combined state and the casting perfectly chilled, is about 1¼ inches to the foot. During the annealing process one-half of this shrinkage is regained so that the total shrinkage is about ⅝ inch to the foot.

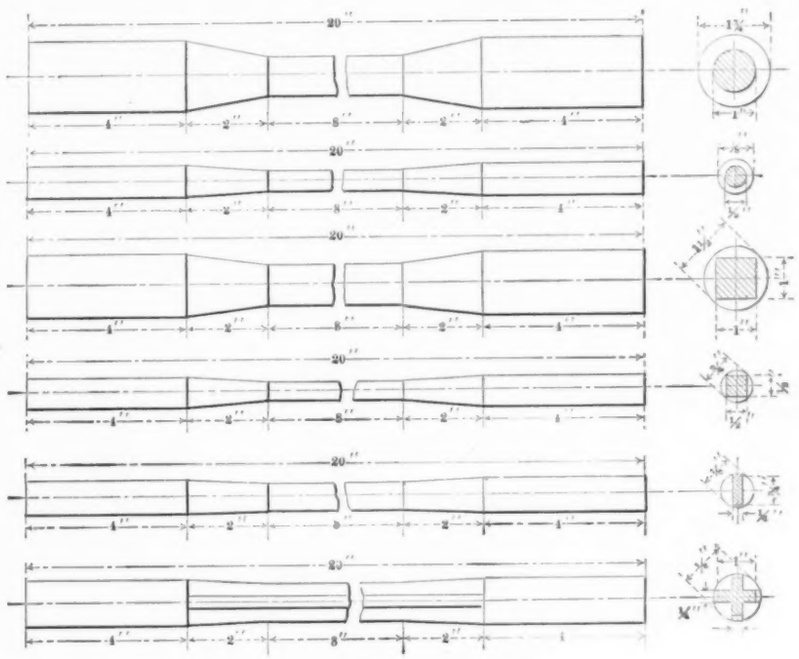


FIG. 3. TENSION TEST PIECES.

If the iron is of the right composition and everything goes as it should the castings should have the following properties: A tensile strength of 42,000 to 47,000 pounds per square inch or even up to 54,000, an elongation of from 2.5 to 5.5 per cent. between points 6 inches apart, and about the same reduction in area. When the tensile strength runs over 47,000 pounds per square inch the elongation has to be sacrificed.

ORIGINAL TESTS.

The tests that follow were made from specimens cast by the Buhl Malleable Company, of Detroit, Michigan. For these castings a mixture of charcoal and bessemer malleable iron was used. The furnaces used are the regular forced-draft furnaces using low-sulphur soft coal. The process of annealing used was the common practice of coal annealing ovens. The packing used was an iron scale sprinkled with dilute muriatic acid. The castings were all made at the same time and taken from an ordinary heat.

The tests were made between May 18,

and June 1, 1904, in the mechanical laboratory of Sibley College. For the larger tension pieces an Olsen 300,000 pound machine was used. For the rest of the tests a 50,000-pound Riehle machine was used.

COMPRESSION.

The form of test bars used is shown in Fig. 1. The results are shown diagrammatically in Fig. 2 and in tabular form in Table 1. The tests were all very satisfactory and all the test bars seemed to be free from blow holes or such imperfections. In all of these tests a micrometer was used to read the amount of compression after each load. From these readings curves were plotted between the load in pounds per square inch and the amount of compression per inch of length. As the first micrometer reading was always taken for the zero none of these curves pass through the origin. These curves show up very well and from them can be seen the evenness with which the specimens were compressed.

These tests were all made on the Reihlé 50,000-pound machine on test bars with square ends. The round sections held the greatest strain, both in the case of the 15-inch and 7½-inch columns. Next in order were the star shaped sections 15 inches long. The square section held the least strain both in the 15-inch and 7½-inch columns. These results would seem to indicate that the strength in pounds per square inch has nothing to do with the length of the perimeter of the specimen.

TENSION.

The form of the test bars used is shown in Fig 3. The results are shown diagrammatically in Fig. 4 and in tabular form in Tables 2 and 3. Tests of malleable iron in tension are of course the best way of finding out the grade of iron that has been cast. Six kinds of test bars were therefore used not only to get fair values of the strength of the iron, but also to find out what shapes would give the best values. The results shown by these tests are as follows:

It was found that in these test bars the round section gave the best results both in the 1-inch and the ½-inch sizes. This fact not only showed up in the tension tests but also in the compression tests. The round section besides having a greater tensile strength also had a greater elongation and reduction in area. This may be due to the fact that the iron casts better in round sections or that the outer skin of a malleable casting is not its strongest part. Every one of the round bars showed a perfect fracture, with a good skin and a smooth velvety interior. It is generally thought that malleable iron does not cast well in round sections and that a section with narrow ribs is the strongest possible section. This is why the star-shaped section was made to test. In only one of the star pieces did the fracture show up well. In the others there were signs of shrinkage. It seems rather strange that these results were quite the reverse from what were expected; the round section being the strongest, next the square, then the rectangular section, and lastly the star; varying inversely as the perimeter exposed.

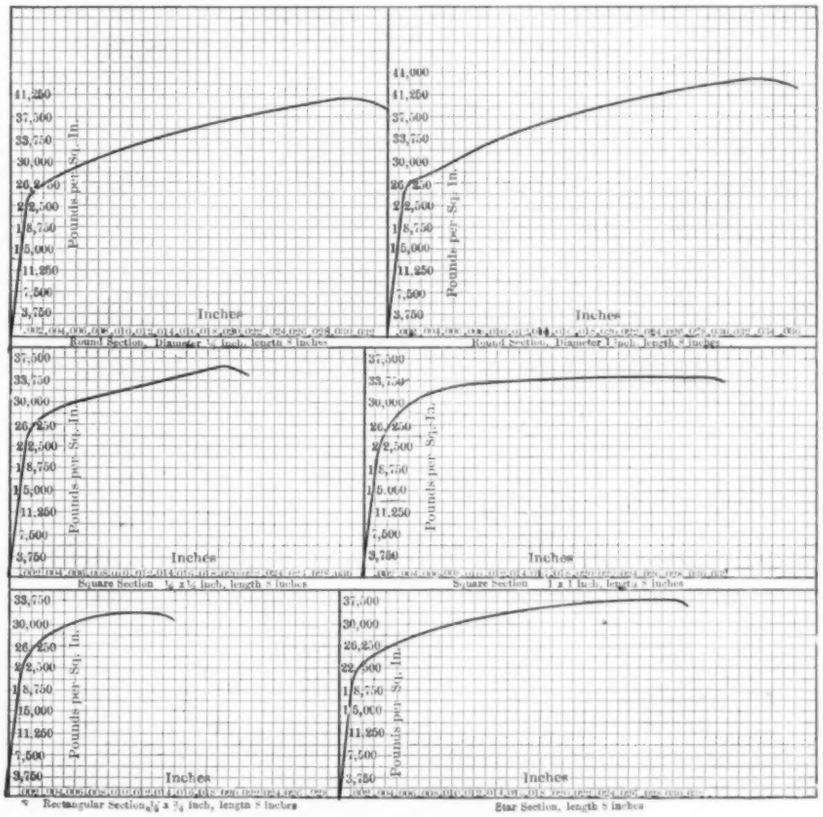

Pounds per Sq. In.
Inches
Round Section, Diameter ½ Inch, length 8 Inches
Round Section, Diameter 1 Inch, length 8 Inches
Square Section ½ x ½ Inch, length 8 Inches
Square Section 1 x 1 Inch, length 8 Inches
Rectangular Section ½ x ¾ Inch, length 8 Inches
Star Section, length 8 Inches

FIG. 4. TENSION TESTS OF MALLEABLE CAST IRON.

The average values from the round test bars give a tensile strength of 43,100 pounds per square inch, elongation in 8 inches 7 per cent. and a reduction in area of 3.75 per cent. Since these test pieces showed the best fractures, they probably give the best idea of the iron used. Comparing these values with other results gave the results of Table 2.

This table shows the iron up very well. The elongation is a little high but otherwise the round-section test bars give values for first-class malleable iron.

Test.	Sect'n.	Area.	L'ngth.	Compressive Strength.	Final Area.
1.	Round	.835	15.0″	32950	.883
2.	Round	.847	15.0″	31700	.901
3.	Round	.801	15.0″	33240	.886
1.	Round	.213	7.5″	33300	.222
2.	Round	.209	7.5″	32600	.221
3.	Round	.204	7.5″	34600	.215
1.	Square	.282	7.5″	32580	.291
2.	Square	.263	7.5″	33200	.272
3.	Square	.254	7.5″	31870	.278
1.	Square	1.051	15.0″	29650	1.070
2.	Square	1.040	15.0″	30450	1.066
3.	Square	1.048	15.0″	29700	1.070
1.	Star	.453	15.0″	31900	.465
2.	Star	.436	15.0″	32200	.448
3.	Star	.457	15.0″	30400	.467

TABLE 1. RESULTS OF COMPRESSION TESTS.

	Tensile Strength.	Reduction Area. Per cent.	Elongation. Per cent.
Best Malleable	46,000	3.5	3.5
Kent's Values	32,000	2.0	.0
Miner & Blake	39,600	4.5	4.6
Mason & Day—			
Round Section.....	43,100	3.75	7.0
Square Section	37,700	2.84	3.2
Rect. Section	37,400	4.25	3.5
Star Section.....	35,500	3.16	5.3

TABLE 2. COMPARISON OF RESULTS.

Test.	Section.	Area.	Tensile Strength.	Elongation in 8 inches. Per cent.	Reduction Area. Per cent.
1.	Round	.793	43100	8.70	3.75
2.	Round	.817	43000	5.87	4.76
3.	Round	.801	43400	6.21	3.98
1.	Round	.219	41130	7.70	3.40
2.	Round	.202	44700	13.00	3.63
3.	Round	.210	43050	5.80	3.52
1.	Square	.277	36700	4.70	2.20
2.	Square	.277	38100	3.72	3.00
3.	Square	.283	37520	4.21	2.71
1.	Square	1.040	38460	4.10	3.30
2.	Square	1.030	38000	1.95	2.88
3.	Square	1.050	37860	2.38	2.94
1.	Rect.	.239	31200*	5.19	1.50
2.	Rect.	.244	37600	3.87	3.80
3.	Rect.	.218	37250	3.22	4.70
1.	Star	.584	34600	4.20	3.10
2.	Star	.523	36500	7.20	2.50
3.	Star	.575	37200	4.80	3.50

* This test piece had a flaw in the shape of a blow hole, and so its tensile strength is far below the average.

TABLE 3. RESULTS OF TENSION TESTS.

The Tygard Internal-Combustion Engine.

The modern application of gasolene engines to the propulsion of balloons accounts for the association with the exhibit of the Aero Club at the 69th Regiment Armory in New York recently of an engine of a very uncommon type, which is remarkable for the fact that, though employing the Beau De Rochas, or four-stroke cycle, and having but one piston, one impulse per revolution is obtained, without having recourse to piston-rod stuffing boxes; and also for its low weight per horse-power, in spite of its strong and substantial construction. This is the Tygard engine, of which we present two longitudinal sections, Fig. 1 being a section through the axis of the shaft, and Fig. 2 a section on a plane at right angles to the first. In addition, Fig. 3 shows the valve on a larger scale; this cut is made from a sketch of a valve differing a little from the one shown in the engine. The first engine built was formed by removing from the crank-case or base of a 3-horse-power De Dion-Bouton motor its water-cooled cylinder and bolting to the same base the cylinder end of the Tygard motor, the result of the change being to leave the weight of the engine at 100 pounds, while the horse-power was increased to six. The present stock engine has the same total weight, viz., 100 pounds, delivers 8 brake horse-power (hence its weight per horse-power is 12½ pounds), has aluminum exterior casing, a cylinder diameter of 3 inches, stroke 3½ inches, distance from center of shaft to top of case 25⅜ inches.

The first striking thing about the mechanical construction of the Tygard engine is that the piston is fixed and the cylinder moves. The divided shaft, cranks and connecting-rod do not differ materially from those usual with the gasolene engines of automobiles and motor-cycles. In the description which follows the engine is regarded as a vertical. *A* is the frame of the engine, *B* is the cylinder, made in top and bottom halves, held together by the bolts *C*. Into the lower half of the cylinder is fixed the wrist pin, passing through the upper end of the connecting-rod. This end of the cylinder is enlarged to slide in the frame *A* and acts as a cross-head, taking the side thrust of the connecting-rod, so that this thrust does not cause a side pressure between the piston and the cylinder. *D* is the stationary piston, which is made gas-tight in the cylinder by packing rings near its upper and lower edges. In order to support the piston the cylinder has, on each side, a slot near its middle, and through this slot project out the lugs *E* of the piston, which are firmly seated in the frame *A*. These lugs are hollow and form the seat for the one rotary valve of the engine, which performs all the functions of the collection of poppet valves, cams, gears, springs, etc., usual on a hydro-carbon engine. Within one of the hollow lugs is also located the one spark plug, which gives the ignition for both the upper and lower combustion spaces. These combustion spaces, as is pretty evident, are formed between the upper and lower heads, respectively, of the moving cylinder and the central fixed piston; the piston itself is hollow and the cylinder heads are introverted or formed with projections into the piston approaching close to its central body. The inlet and outlet to each of these combustion spaces are through ports (*F* and *G*) cut through each piston face into a valve-seat located in a bore extending completely through the piston and the lugs on each side of it; into this seat is fitted a plug valve *H* having a small amount of taper. This valve is a hollow gray-iron shell with ports which communicate alternately with the fuel supply and with the exhaust outlet. It is continuously rotated at one-half the speed of the crank-shaft by a silent chain drive, the sprocket wheels *J* and *K* of which are visible in the illustration. The pull of the driving chain is prevented from coming on

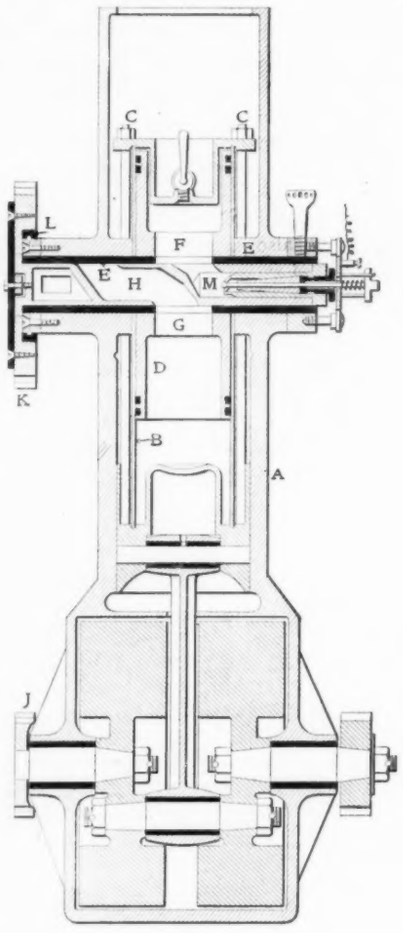


FIG. 1.

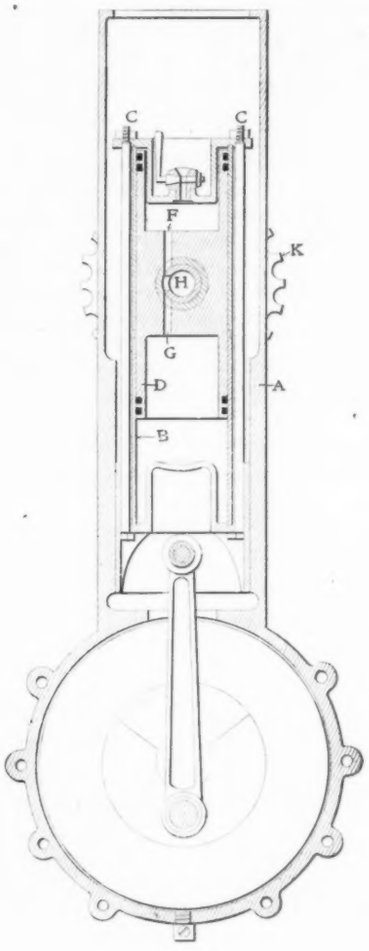


FIG. 2.

THE TYGARD INTERNAL COMBUSTION ENGINE.

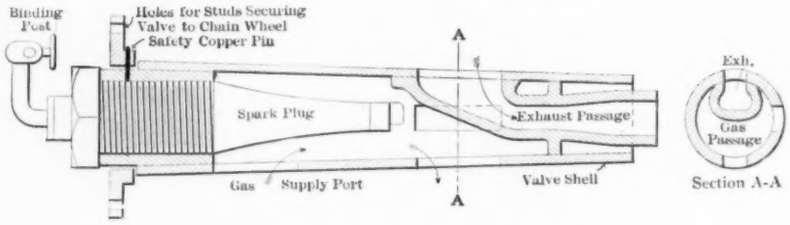


FIG. 3. SECTIONS OF ROTARY VALVE.

Revolution.	Stroke.	Direction.	Upper Space.	Lower Space.
1.	I.	Upward.	Combustion and Expansion.	Exhaust.
	II.	Downward.	Exhaust.	Admission of Charge.
2.	III.	Upward.	Admission of Charge.	Compression.
	IV.	Downward.	Compression.	Combustion and Expansion.

TABLE SHOWING COMPLETE CYCLE OF THE TYGARD ENGINE.

the valve by the ball bearing *L*. The charge is admitted to the cylinder during the suction stroke through the valve, which then becomes closed during the compression stroke. One end of the valve contains the spark plug *M*, which is allowed to act on the compressed charge in the combustion space by the ignition port in the valve coming opposite one of the ports *F* or *G* at the proper instant. When the expansion or working stroke is completed, the revolution of this single valve has brought its exhaust port into register, and the movement of the cylinder against the end of the stationary piston expels the exhaust into the atmosphere. The accompanying table presents the complete cycle during two successive revolutions, from which it will be seen that there are two explosions in every four strokes of the cylinder, these occurring alternately in the upper and lower combustion spaces. A collar on the valve is so adjusted as to hold it away from its seat a minute distance, just sufficient for a film of oil, the oil being automatically drawn in along the seat at every second revolution of the engine.

In the sketch, Fig. 3, which is not to be taken as an exact representation, there can be seen, inside of the cast-iron valve shell tapered inside and out, a separate plug which is made a ground fit inside the shell, this plug serving to carry off the exhaust from the upper and lower combustion spaces alternately. A threaded bushing is fitted into the large end of the valve shell, and into this bushing the spark plug is screwed. The valve is rotated by means of a driver fastened to the chain wheel by studs, spaced unequally so that it is impossible to replace the valve in a wrong position or out of time. The driver drives the valve through a copper pin, which would shear off in case the valve should seize in its tapered seat for lack of oil, and thus the surfaces are protected against galling in case of neglect.

This engine, besides the usual throttling of the fuel supply, possesses a feature which adds greatly to its range of speed or power control, viz., it is provided with a valve which enables one end of the cylinder to be "cut out," thus making a single-acting engine, cutting the power in two, but retaining full compression for the end of the cylinder still in action. This gives to the engine a facility which would ordinarily require two cylinder. The engine is built by J. W. Tygard, Plainfield, N. J.

The Washburn shops of the Worcester Polytechnic Institute have received a first prize at Liège for their exhibit of drill grinders. This was the only award given to any school shop, either trade or engineering, for manufactured products. The shops have recently received from South America a number of orders for machines for driving screw spikes for fastening railway rails to the ties. This matter seems to still be in the experimental stage but the experimenting seems to be going on the world over.

The March Reunion of the American Society of Mechanical Engineers.

The March reunion of the A. S. M. E. was held at the society house the evening of March 27. The speaker of the evening was C. J. H. Woodbury, his subject being "The Mechanical Engineering of Telephone Systems."

The speaker showed a chart of the growth of business of the Bell Telephone Company, being a plot of the number of subscribers from 1876 to date. This made evident a very slow growth up to 1896, at which time a sudden and rapidly increasing growth developed. The growth, development and activity of other telephone systems were not referred to.

Pictures of the various shops of the Western Electric Company in New York, Philadelphia and Boston were shown, with a statement of the number of employees, number of standard parts made, and of various shapes and sizes of switchboards, showing their operation by the employees. In these shops the Bell telephones are made. Enlarged models of the receiver and mouthpiece at present used were also displayed, explaining the use of carbon plates and balls to intensify the transmission of sound, and the operating dynamo producing the current necessary to furnish current for large stations was also illustrated.

The speaker asserted that the development of sky-scrapers would have been impracticable without the telephone.

It was pointed out that railway-telegraph stations had frequently been known to act as telephones, transmitting speech along the lines audibly, before the actual development of the telephone, and as an explanation it was stated that the carbon deposited in the telegraph instruments from the engine smoke converted them into microphones.

Samples of cold-drawn copper wire, No. 8 B. & S. gage, were shown, which were stated to have a tenacity of 64,000 pounds per square inch.

It was also stated that the introduction of the telephone had resulted in the liberation from drudgery of an immense number of messengers, who now found employment in shops of various kinds.

Professor Hutton tenders his Resignation as Secretary of the A. S. M. E.

At a meeting of the Council of the American Society of Mechanical Engineers January 29, Prof. F. R. Hutton presented the following letter.

Gentlemen—It may be known to some members of the Council that for several years I have had the thought in mind of resigning the Secretaryship of the Society, on the completion of twenty-five years of service. I was first elected in March, 1883. My more recent thought has been that instead of waiting for a merely sentimental period to elapse, which would have meaning to myself alone, I might rather emphasize the more obvious culmination of my service to the Society by withdrawing at the time when the Society shall cross the threshold of its new home in the Engineering Building. It will then have been given to me to have wrought for the Society from the days of small beginnings, when I paid my own office rent and expenses, through the period of rented offices, and of the ownership of the modest home in Thirty-first street and up to the opening of the days of larger opportunity in the splendid surroundings of the new enterprise. It is wise, I am sure, that at the time of this external change the Society should also make the internal change incident to securing as its Secretary one who will and can devote his entire time to the work and development of the Society.

It is well known to you that I have felt that I must owe and pay my first allegiance to the work of my professorship in Columbia University.

This being the case, the Council should be advised far enough in advance, so that the least embarrassment may be entailed by my withdrawal. I have therefore thought it best to present this formal letter at the first meeting of the year, and to ask by it that proper action may be taken looking to the question for the future which it raises. I ask that I may be relieved of the duties of the Secretaryship at the end of the current society year, or at such other time thereafter as the Council may see fit to have this resignation take effect.

It would be my wish and preference that no unnecessary or premature publicity be given to the fact of my decision. I seek to avoid having anything like a "fuss" made.

A solder for aluminum has been invented, says Consul Atwell, of Roubaix, by Fernand Hecht, a mechanic of that city. With a soldering iron he can join together two pieces of the metal or join aluminum to copper, brass or iron. The invention is simple, no acids or salts being used. Mr. Hecht exhibited his process satisfactorily before the professors of chemistry of the Faculty of Science, and was also awarded a medal from the Northern Industrial Society of France for making a discovery of great importance.

Standard time was adopted in India January 1, and is said to be gradually overcoming the prejudice incident to a new departure. The time is that of the local mean time, of the meridian of longitude 5½ hours east of Greenwich, so that it is 10½ hours ahead of New York or Eastern standard time.

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Contents.

	PAGE
Some Shop Methods of the American and British Manufacturing Company	431
The Demand for Denatured Alcohol—Testimony before the Congressional Committee	435
Osborn's File and Twist Drill Factories at Sheffield, England	438
A New Firm of Lathe Builders	444
Studies in Inventive Problems—XVI.	444
A Machine-made Stalagmite	449
Letters to the Edtor: That Molding-Machine Proposition....Making Wood Carrier Rolls for Textile Work....Grinding Rig for Rotary Planer Cutters....Shop Lavatory and Meal Arrangements....Making Solder Rolls....A Multiple Boring-Tool Holder....More Kinks for Patternmakers....Cutting a Cavity at the Bottom of a Hole....Shearing Wire in a Lathe....Keeping the Hands Clean—Wearing Gloves in the Shop....Apprenticeship and Industrial Education—Attracting and Holding Desirable Apprentices	450-457
Legal Notes	457
Malleable Cast Iron	458
The Tygard Internal Combustion Engine	462
The March Reunion of the A. S. M. E.	463
Professor Hutton Tenders his Resignation as Secretary of the A. S. M. E.	463
Some Impending Changes in the A. S. M. E.	464
Alleged Monopoly of Machinery	464
Workingmen in Politics	465
New Publications	465
The Crusade Against Tuberculosis	465
New Tools and Machine Shop Appliances	466

Some Impending Changes in the A. S. M. E.

The more intimate personal friends of Prof. F. R. Hutton have for some time been aware that he has contemplated resigning his position as secretary of the American Society of Mechanical Engineers, though it had been thought that he might defer doing so until he should have completed his 25th year of service in that capacity.

Recently, however, the work connected with the conduct of the society's business has increased to such an extent that it has seemed to him impracticable to continue to carry the burden along with his work as the head of the department of mechanical engineering of Columbia University, to which he feels he owes his first allegiance.

Believing that the time has arrived when the society should have a secretary who can devote his whole time and energy to the work of the society, Professor Hutton presented to the Council at its meeting in January a letter of resignation. This was not accepted, but action upon it was deferred to give opportunity for conferences with absent members of the Council and others, the idea being at the same time advanced that perhaps the services of Professor Hutton might be retained for the conduct of meetings and for the performance of other functions for which he has proven his exceptional fitness; the society employing another man to attend to and supervise the detail work of the secretary's office and to be the business manager; this last-mentioned man to have the title of Secretary and Professor Hutton some such title as Honorary Secretary.

This plan now seems in a fair way of being carried out. The Council at its meeting of March 27 approved the general plan and gave power to a special committee to carry out the necessary arrangements; to select the new man and to rearrange the methods of the office and its personnel, if necessary, in order to institute the new regime.

In this way the society may for a long time secure the benefit of Professor Hutton's special skill, ability and experience, while at the same time the aim will be to secure an efficient manager for the society's business and routine work, and one who can give much more time to it than it is possible for Professor Hutton to give.

This action by Professor Hutton has called forth many expressions of the highest appreciation of the work he has done on behalf of the society during the 23 years he has been its secretary. It is generally recognized that in the work of building up the society his services have been invaluable, and that for the high position the society occupies today its members are very largely indebted to him. It is especially fortunate that it has been possible to so arrange things as to retain his services for those duties for which he has shown ability amounting to genius.

It is to be understood that Professor Hutton has not retired, and that no change has as yet taken place, but arrangements have been made for making such changes as we have outlined as fast as circumstances will permit without embarrassment to the society.

Alleged Monopoly of Machinery.

David M. Parry, president of the National Association of Manufacturers, has written a novel which is designed to depict the style of living which would be inflicted upon human beings living under the socialistic regime. We are by no means sufficiently well acquainted with socialism to judge as to the accuracy of the picture Mr. Parry draws; but a somewhat extended preliminary notice of the book, which appeared in a New York paper, has brought out a reply from a socialist, Maurice Hillquit, in which we note the following curious and interesting statement:

"I only reckon the beginning of socialism perhaps somewhere soon after the year 1800, when industrial conditions were being worked out on a basis that destroyed the individual tool and created the class of wage-earners. Before machinery existed every man owned his tools, and, save for his term of apprenticeship, he was free to set up in business for himself. The ownership of his tools made him independent of anyone but his own industry and ability. Only when the simple individual tool had developed into the costly social machine of today, the private ownership of that machine by the few became unjust and oppressive to the many, and modern socialism, i. e., the movement to do away with the private ownership of the machine and all other means of production and distribution, became possible."

Now it seems to us that in the above Mr. Hillquit shows an utter failure to distinguish between a real monopoly and a thing which is not a monopoly at all. We know of plenty of machinery builders who will build machinery of any kind for anyone who has the money to pay for it, and in these days of partnerships and of stock companies, etc., almost anyone can become the owner of machinery, or can own stock in a corporation which does own machinery. To mention a single instance—not because it is the only one, but because it is promient and familiar—let us suppose that the engineers and miners employed by the anthracite coal trust, together with the dealers in anthracite coal, should get together, form a joint stock company and order an outfit of coal-mining machinery. They would have no difficulty in securing such an outfit and would then, so far as the possession of machinery is concerned, be in position to

compete with the anthracite coal trust. In fact, they would probably have an advantage of the trust in that respect, because their machinery would be more uniformly modern and probably of considerably higher average efficiency than that of the trust. But what would they do with this machinery after they had got it? Where would they find a place to use it, so long as the anthracite coal trust owns practically all the land in which anthracite coal has been found? And so long as the same trust controls the lines of transportation by which anthracite coal can reach the market, how could the newly-formed company get its product to market, supposing that it had found a place in which its new and efficient machinery could be employed in mining coal?

The fact is that there is practically no monopoly in the building or ownership of machinery. Here and there in a few industries, and by means of patents which are of limited duration, certain companies are partially fortified against competition in this way, but these cases are the exception and are by no means sufficient to account for the social phenomena against which socialists are contending. There is precious little monopoly in machinery, and some of the most strenuous competition to be found on earth may be seen among builders and users of it.

We do not believe in monopolies, but we do believe that in order to fight them effectively people must first learn to know a monopoly when they see it, and not be wasting breath and effort against things which are not monopolies at all.

Workingmen in Politics.

A distinguishing feature of public life in America is that it has not been customary for workingmen and their employers to divide on questions of politics. They have been influenced by other considerations than that of their relation as employer and employee, and it has generally been recognized that the political interests of the one were very closely identified, if not exactly the same, as those of the other. This, however, seems likely to be changed, and the recent action of the executive council of the Federation of Labor in reaffirming its decision to go actively into politics is significant as bearing upon this question. The council declares that the working people must unite and organize irrespective of creed, color, sex, nationality or politics, and that it firmly and unequivocally favors the independent use of the ballot by the trade unionists and workingmen, united regardless of party. The policy of questioning candidates for office upon matters affecting the interests of labor and the working people generally is to be continued more aggressively than in the past.

It is probable that the result of the recent election in Great Britain has stimulated this action of the representatives of American labor unions, and the general fight now being made against the closed shop, and the organized resistance made by the National Manufacturers' Association and others against bills advocated by labor men have also undoubtedly had their effect.

There can, we think, be little doubt that sooner or later workingmen here will do much the same as they have done in other countries and will put up candidates of their own or support those only who are satisfactory to them. It is pretty certain that the late Mark Hanna foresaw that and designed to do what he could to prepare for it.

With political power will arrive political responsibility, and the effect of this may be to cause the abandonment of some schemes which workingmen now think they would enact into law if they could. At any rate, the realization of the fact that they can, by methods prescribed by our Constitution and laws, bring about such reforms as they may be able to persuade their fellow-citizens are needed, or are just, will have an educational and a steadying influence.

Men at the head of important manufacturing enterprises in Switzerland declare that the direct participation of workingmen in the enactment of laws there is not prejudicial to manufacturing interests, but that they exercise their powers with care and with due regard to the rights and interests of manufacturers. We are loth to believe that our own workingmen would be less fair and reasonable under similar circumstances.

The Crusade Against Tuberculosis.

The Journal of the Outdoor Life, published at Trudeau, N. Y., in the Adirondack mountains, has been made the official organ of the National Association for the Study and Prevention of Tuberculosis, of which Dr. Herman M. Briggs, medical director of the New York City Health Department, is president. The membership of the association includes the leading workers in the field of tuberculosis, both lay and professional, throughout the United States and Canada.

The Journal of the Outdoor Life aims to be helpful to persons suffering from or having a tendency toward lung trouble. It deals with the outdoor treatment of tuberculosis in an intelligent and scientific manner, and while not advocating self-treatment by the laity, or attempting to supplant personal medical advice, it points out some of the common pitfalls that beset the unwary health-seeker. It advocates fresh air, nourishing food, carefully regulated exercise and competent medical supervision.

The Journal of the Outdoor Life is not devoted exclusively to the subject of tuberculosis, but aims to publish readable, practicable, and useful articles on how to get the most benefit, satisfaction and happiness from an outdoor life.

The subscription price is one dollar a year, or ten cents a copy.

New Publications.

"Valves and Valve Gear Mechanisms." By W. E. Selby. 366 6x10-inch pages, with 202 illustrations. Edward Arnold, London, Longmans, Green & Co., New York. Price, $6.

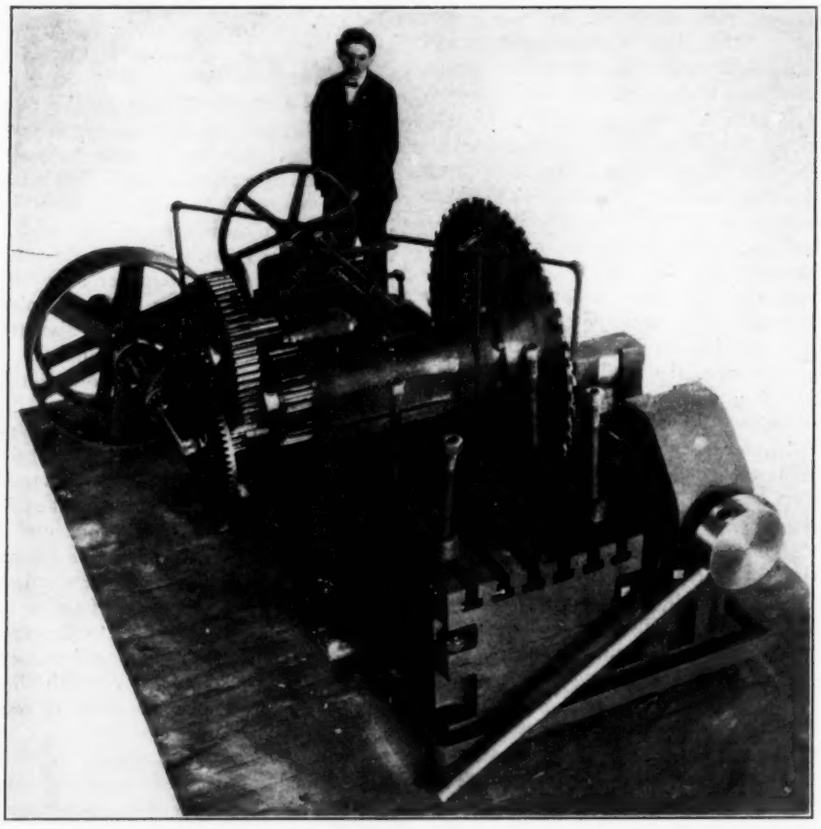
This is undoubtedly one of the most complete, if not the most complete, book on valve gears in the English language. It is distinctly a treatise rather than a text book or manual. As befits a book which proposes to discuss most of the leading types of valve gears, it prefaces the treatment of gears with a chapter on valves, in which all the leading kinds of valves used for steam distribution are discussed independently of the mechanisms by which they are moved. Following this, the crank and connecting rod are discussed, and then comes a chapter on the simple eccentric gear, the problems being solved by no one diagram, but by several of the leading ones. Practically all of the leading valve gears which find use on stationary, marine and locomotive engines, at least to any large extent, are discussed at length and their methods of laying out are explained. In addition to the valve diagrams, a chapter is given to the analytical method of solution, by which those who prefer to use mathematics in valve designing can be accommodated.

Presumably because we have had something to say about the rascally manufacturers of so-called patent "medicines," and the exposures of them which have recently appeared in certain prominent journals, we are favored with a pamphlet reprinted from *The National Druggist* of St. Louis, in which an attempt is made to reply to these exposures. The attempt is probably about as good as could be done, but it is a poor thing, and is a monumental example of special pleading. What it does is simply to charge the doctors with a lot of wickedness of various sorts, but so far as we can discover it presents no good reason or excuse why men should sell vile whisky under the name of medicine, and at very much above its value, nor why they should sell to people drugs that are injurious to them and tempt them to become their own diagnosticians and doctors. We do not believe in that sort of thing, and believe that people who dose themselves with preparations of this sort should at least be provided with the means of knowing what they are swallowing. We do not at all believe the charges that are brought against the doctors in this pamphlet, but even if they were all true they constitute no reply to the charges brought against patent medicine manufacturers, by journals abundantly able to pay libel damages if awarded.

New Tools and Machine Shop Appliances.

A HIGH-DUTY SAW.

The illustration shows a high-duty saw which has just been shipped to the American Locomotive Company. This machine



A HIGH-DUTY SAW.

was designed primarily for sawing 13-inch square 0.60 carbon-steel billets into convenient lengths for forging into iocomotive driving axles. Heavy forgings and castings can also be handled by the machine by removing the special appliance fitted to the machine for handling billets.

The "Tindel" saw blade, with which the machine is equipped, is 48 inches diameter by ⅝ inch thick and has 76 high-speed steel cutters on alternate sides of the blade. The capacity of the saw is 16 inches depth of cut.

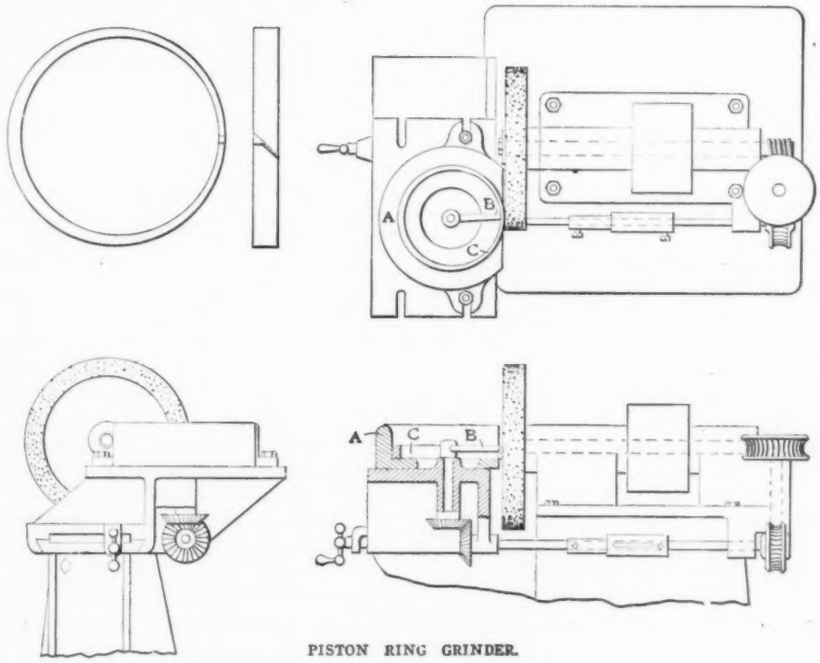
The housing and bed plate of the machine are cast in one piece to insure rigidity. The vise and supplementary table are secured by large bolts. Both the supplementary table and the vise are removable, leaving the bed plate available for bolting castings, forgings. etc., to.

The initial drive is 20 h.p., with a ratio of 60 to 1 between the pulley and the saw. The drive is through spur and bevel-gear train, no worm gearing being used in the saw drive. The spindle is of high-carbon steel, running in a solid tapered bearing 30 inches long, cast in one piece with the carriage. The carriage has a bearing on the bed 26x30 inches and is gibbed back and front with phosphor-bronze taper shoes. The feed for the saw is by friction disks through worm and worm-wheel to a screw and long nut in the back of the saddle. The friction feed gives a greater range of feeds than would be possible through gearing.

The minimum feed is ½ inch and the maximum 1¼ inches per minute. The peripheral speed is in two steps, 35 and 55 feet per minute. An automatic stop is supplied, so that the depth of cut is at all times under the control of the operator. A rotary pump, driven by a small belt from the main shaft, supplies lubricant for the saw. The machine weighs approximately 10 tons. Trials of this machine showed that it would take a cut of 1 inch per minute on 14-inch square 0.50 carbon-steel billets without sign of distress. This machine is built by the High Duty Saw and Tool Company, Eddystone, Penn.

PISTON RING GRINDER.

This machine is designed for grinding various sizes and kinds of piston rings, one or more at a time, and for grinding them in place in the piston, or separately, as desired. In the case of gas-engine rings, they can all be placed in the piston and ground simultaneously. The principal feature of the machine is that the rings are ground under the same stress or tension that they are subject to when working in the cylinder. In the engraving, *A* is a form clamped to the grinder table; this form or holder is bored to the exact size of the cylinder the ring is intended for and is flattened on one side tangent to its bore, which allows the emery wheel to reach the ring, which, after being forced into the form, is revolved slowly by the finger *B*, which in turn is driven by worm reduction gear from the emery-wheel spindle. This permits the ring *C*, which is exposed through the flat side of the holder, to come in contact with the emery wheel and to be ground only at points where needed, that is, on the high spots. It also permits the ring to adjust itself to the changing tension taking place so as to be brought down to a true circle. When the rings are ground in place in the pis-

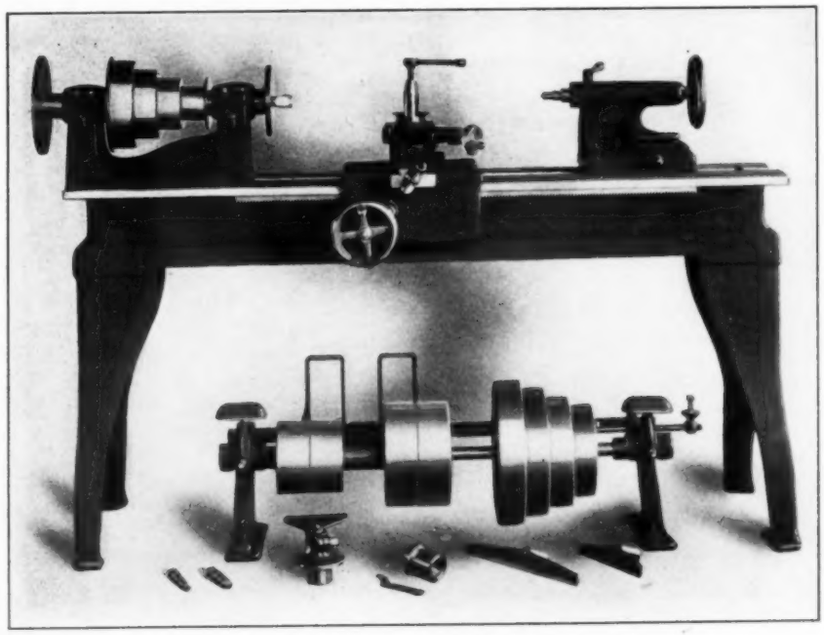


PISTON RING GRINDER.

ton, the fixture *A* is made deep enough to receive the whole piston, the finger *B* is removed, and the piston is revolved by suitable driving pins which it is drilled to receive. The inventor of this machine is W. Chambers, 1379 Bloor street, West, Toronto, Canada.

16-INCH PATTERNMAKERS' LATHE.

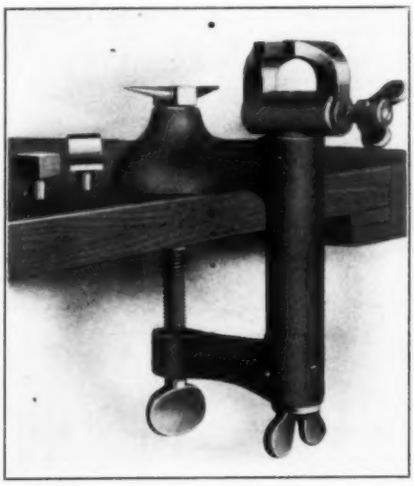
The patternmaker's lathe, shown in the half-tone, is improved and made heavier than the previous model of the same manufacturer. Its head spindle runs in ring-oiling phosphor-bronze bearings, and is provided with a large outer face plate and tripod rest for turning larger work than will swing over the bed. The head cone is turned on the inside to secure a perfect balance, and has four sections for 2¼-inch belt, giving with the 2-speed countershaft eight spindle speeds arranged in regular gradation. For convenience in using twist drills, chucks, etc., the center holes in both head and tail spindles are made to standard No. 3 Morse taper. The carriage has hand feed the entire length of the bed, to which it is gibbed on front and back sides. The compound tool block is graduated in degrees, and interchanges instantly with a holder carrying the tool rests for hand-turning. The tailstock sets over for turning taper on work between the centers, and is of the latest pattern, allowing the compound to be used when swiveled parallel to the ways. The countershaft is of the tight and loose pulley type, having two pairs of self-oiling tight and loose pulleys of different size, arranged with a simple shifter mechanism, whereby only one shipper is required for both belts; the shipper motion is identical with that in a friction countershaft. The hanger boxers are self-oiling. Each lathe is provided with 2-speed countershaft, tripod rest, pair of wood centers, pair of pointed centers, two face plates, screw plate and necessary wrenches. The lathe will swing 16¾ inches in diameter over the bed, 12¼ inches in diameter over the carriage, and on a 6-foot bed will take 39 inches between centers. The exact weight with a 6o-foot bed is 1040 pounds. The maker is L. Robbins, 42 Lagrange street, Worcester. Mass.



16-INCH PATTERNMAKERS' LATHE.

A SMALL COMBINATION VISE, CLAMP AND ANVIL.

This tool is designed for the use of tool-makers, jewellers and machinists doing small work. It comprises a drop-forged hand-vise with parallel jaws; a clamp and anvil-base in one piece; a drop-forged horn and square anvil, and a hardie. The hand-vise is easily secured to and removed from the clamp. The handle of this vise extends into the clamp and is secured by a screw at the bottom. The jaws of the vise, the anvils and the hardie are polished. It is manufactured by the Billings & Spencer Company, Hartford, Connecticut.



A SMALL COMBINATION VISE.

A DRIVER FOR TAPERED WORK.

The illustrations show a driver for use when milling tapered work. The dog *A* has a tail *B* which is a snug sliding fit in a hole in the ball *C*. The ball *C* is a snug sliding and turning fit between the curved inner surfaces of the two members *D* of the driver clamped on the center *E*. The ball *C* can move to and from the center between the curved inner surfaces of the members *D*, or can oscillate as shown by the full and dotted lines in Fig. 2, while *B* can slide to and fro in the hole in the ball *C*. All the wearing surfaces are hardened and ground so that there is little wear. A single dog is supplied which will take from ¼ to 2 inches, or three dogs viz., 1, 1½ and 2 inch if preferred. This appliance is manufactured by the Novelty Manufacturing Company, Worcester, Mass.

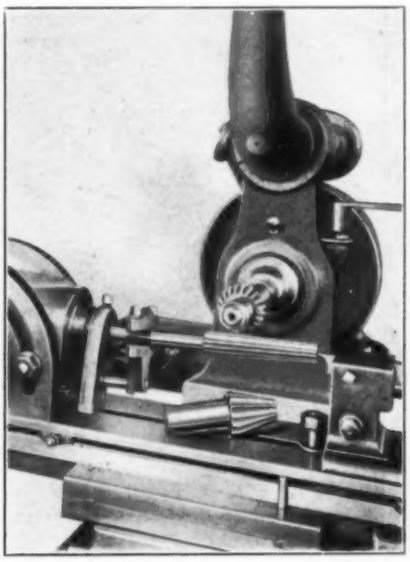


FIG. 1. A DRIVER FOR TAPERED WORK.

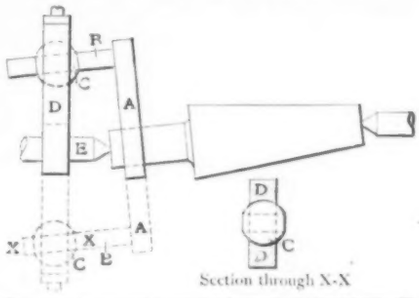


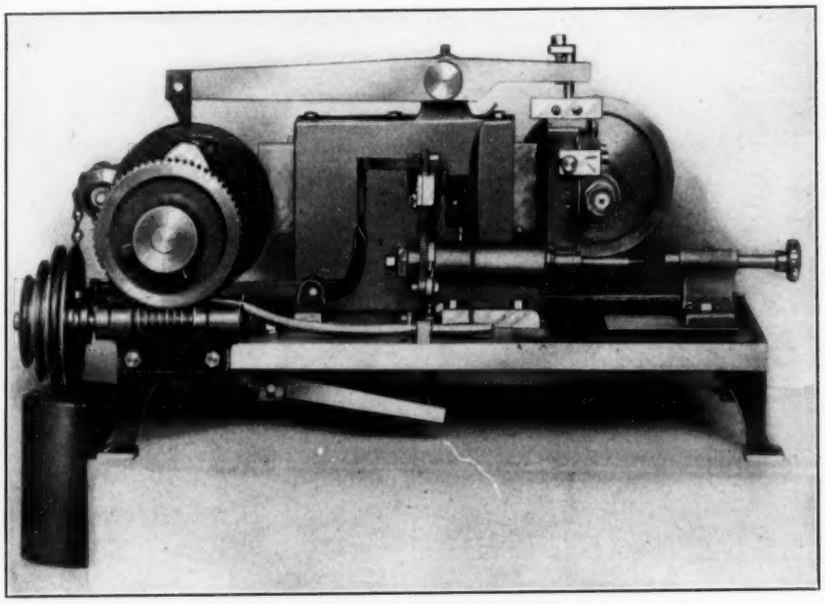
FIG. 2. THE ACTION OF THE DRIVER.

A SMALL AUTOMATIC GEAR CUTTER.

The illustration shows a machine designed to cut spur and bevel gears up to 4 inches diameter in stacks 2 inches thick, and also for the rapid production of watch and clock pinions, small bevel-gear cutters, nurls of irregular shape, electrical apparatus, etc.

The work is mounted upon the work arbor shown in the front. The cutter ar-

bor is mounted on the end of the broad feed slide at the back. The feed slide is actuated by a cam mounted on the shaft at the left. A cam on this shaft also operates the indexing through the lever shown underneath the machine. The large lever on top of the machine in connection with a cam regulates the depth of the cut. The slide which carries the cutter head is lifted clear of the blank at the end of the cut and the indexing is done during the return of the feed slide to cutting position, so that a minimum amount of time is lost. The top of the cutter-head slide is provided with a cam; in the illustration it is shown as a straight piece of steel held in place by two screws. As the feed slide travels, this cam bears against the adjustment pin in the top lever. It is obvious, if this cam be made with an irregular outline, this outline will be duplicated on the work. For bevel gears the straight-faced cam is set at an angle. The return stroke to cutting position occupies only about one-tenth of the cutting stroke, so that very little time is lost. Two changes of speed are provided for the cutter and nine changes of feed. An automatic device stops the machine when the index has made a complete turn.



A SMALL AUTOMATIC GEAR CUTTER.

This machine is made by the Standard Manufacturing Company, Bridgeport, Connecticut.

The Halcomb Steel Company, Syracuse, N. Y., sends us a "Catalog and Hints on Steel," which though it is a catalog, is more than that, as its "hints on steel" are likely to prove valuable to very many of those who are using steel in any way. Aside from this, the book is an unusually attractive example of the printer's and bookmaker's arts. It is beautifully printed in colors and the color scale, showing the appearance of steel when being heated and, as near as can be, the degrees (Fahrenheit) corresponding to the various colors, is especially noteworthy.

Personal.

John Olson has accepted a position with The Union Twist Drill Co., Athol, Mass., as foreman of the hardening department.

Herbert C. Thompson, formerly with Brown & Sharpe, has taken a position as foreman of the cutter department of The Union Twist Drill Co., Athol, Mass.

L. E. Dickinson, W. P. I., '03, has resigned his position with the General Electric Company, at Schenectady to go with the General Storage Battery Company, at Boonton, N. J.

Fred A. Bigelow, W. P. I., '91, has left the Crucible Steel Company of America to accept a position as salesman for the Carpenter Steel Company, with headquarters at Providence, R. I.

J. C. Mitchell, formerly with the Atlas Engine Works, Indianapolis, Ind., has accepted a position in the sales department of the Dayton Pneumatic Tool Company, with headquarters at Dayton, Ohio.

At the recent annual meeting of the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, the office of general manager, which has been vacant since the death last June of Charles H. Wellman, was filled by the election of S. H. Pitkin, whose present title will be first vice-president and general manager. Otherwise no changes were made in the officers of the company.

J. Henry Drury has been appointed assistant treasurer and sales manager of the Union Twist Drill Co., Athol, Mass., manufacturers of milling cutters and twist drills, and is now permanently located in Athol. Mr. Drury was for a number of years with the Brown & Sharpe Mfg. Co., but has more recently been secretary of the Machinery and Supply Dealer's Association. Few men have a better acquaintance with the trade here and abroad, and his accession will, of course, strengthen the new organization.

Obituary.

Edward Martin, for years employed as a foreman at the Camden Iron Works, Camden, N. J., died recently at his home in Westmont, N. J., aged 68 years.

George W. King, who invented and patented many devices, including relays used by telegraphers, and an automatic weighing scale, died March 21, at his home in Georgetown, D. C., aged 66 years.

As we go to press the announcement is made of the death at Trenton, N. J., on March 30, of John Christian Kafer, the well known naval and mechanical engineer. The death also is announced of Thomas R. Almond, of Yonkers, N. Y., who died March 31. An account of the careers of these two men will be given next week.

Allen Gardner Sinclair, who was for many years an expert in heavy ordnance in the employ of the Government, died March 15, at his home in Brooklyn, N. Y., aged 81 years. He was born at Hardwick, Vt., and was employed in the United States Arsenal at Springfield, Mass., when the Civil war started. Mr. Sinclair came to New York City, and was put in charge of most of the ordnance that was shipped to the front. After the war he was appointed superintendent of the Government proving grounds at Sandy Hook, holding that position for fourteen years.

John James Robertson Croes, formerly president of the American Society of Civil Engineers, died March 17 in Yonkers, N. Y., 71 years old. He was engaged in the construction of the Brooklyn water works from 1857 to 1860 and on the Croton water works extension in 1860. He was first assistant engineer of the Washington Aqueduct in 1863 and later was in charge for two years of the construction of the storage reservoirs in the Croton watershed. He was engineer to several rapid transit commissions and until 1891 was the chief engineer of the Suburban Rapid Transit Railroad. From 1903 until a year ago Mr. Croes was consulting engineer to the State Health Department, and besides writing numerous reports, he contributed largely to engineering literature. Mr. Croes was a member of various engineering and kindred associations. He was president of the A. S. C. E. in 1901.

Cornelius J. Ryan, the New York contractor who died recently, was in the past associated with John B. McDonald, the subway builder, in many important operations. Since the completion of Mr. Ryan's work in the construction of the Croton dam, which began in 1892 and ended in 1900, he had practically retired from active business. From 1873, when Ryan and McDonald built the Fourth Avenue tunnel for the New York Central Railroad, until six years ago he was chief constructor of some of the most important works in the United States, his firm during this period building many railway lines and extensions. His greatest work was probably in connection with the building of the famous B. & O. tunnel under Baltimore. Mr. Ryan owned a large interest in the South Baltimore Car Wheel and Foundry Company, which was originally organized as the Ryan & McDonald Construction Company.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago, Ill.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

"Trigonometry Simplified," 50c. National Book Co., 615, N. Eng. Bldg., Cleveland, O.

Parallel attachments for drawing tables. F. G. Hobart, Beloit, Wis. Dealers or by mail.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Want—To buy part or whole interest in small plant manufacturing novelties. Box 391, AMERICAN MACHINIST.

Special machinery to order. Inventions developed. Geo. M. Mayer, M. E., 1131, Mouadnock Bldg., Chicago, Ill.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—A 36-inch Gleason bevel-gear planer in good condition. Address, giving full particulars. Box 369, AMERICAN MACH.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford st., Philadelphia, Pa.

Wanted—Second hand planer, 32" or 36" x 36" x 6 to 10 ft. Quote lowest price with description. Groton Machine Tool Co., Groton, N. Y.

Work Wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Wanted—Full particulars from builders of motors or steam engines suitable for aerial or nautical use about 100 c.h.p. Box 374, AMERICAN MACHINIST.

Wanted—Second-hand copper vacuum pan, 30-40 gals. condenser and pump complete, must be in good working order. State price. Address 10 Christopher St., N. Y.

Gray Iron Foundry in New England desires to take up the manufacture of some specialty requiring high-grade castings, preferably castings having intricate cores and requiring minimum of machining. Box 344, AM. M.

Tool Catalog No. 22, 950 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

For Sale.

For sale—Foundry, Wood & Iron machine shops, Albion, N. Y. Box 74.

For Sale—Patented specialty which no machine shop can afford to be without. Box 379, AMERICAN MACHINIST.

For Sale—Half or whole interest in well established machine shop, with specialties to manufacture. A good opening for a practical man. Address Box 154, Bridgeport, Conn.

Business Opportunities.

Mechanical engineer needs $25,000 to manufacture machinery. Drawings and model ready. Patents all over the world. Box 402, AMERICAN MACHINIST.

A first-class mechanical engineer having a standard line of machinery to manufacture, wants parties to take up its manufacture. Box 355, AMERICAN MACHINIST.

A Manufacturing Concern having a varied line of machinery, wishes to dispose of one of its lines which consists of stationary gasolene engines. These engines run in sizes of from 2 to 20 H. P., and are adapted for all kinds of work. Business in this line has run $50,000.00 a year. Patterns, drawings and good will will be sold at a reasonable figure. Parties desiring to add another line to their business, or those desirous of going into the manufacturing business will find this to be an interesting proposition. Address Gas Engine, 260, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Expert accountant and office manager desires position. Familiar with all branches of office work. References. P. O. Box 55, Hartford, Conn.

ILLINOIS.

Position as Manager or Superintendent of a plant building either gas engines, steam engines, pumps or heavy machine tools. I have held same position for ten years and am up-to-date in modern methods and shop system. G. V. Mitchell, Chicago Heights, Ill.

IOWA.

Chief Draftsman: a mechanical engineer, at present chief draftsman with a large manufcturing concern in the west. Box 269, AMERICAN MACHINIST.

MASSACHUSETTS.

Toolroom foreman, by a practical, technical and inventive, 12 years experienced toolmaker, 31, on tools, jigs, fixtures and high-speed steels. Box 401, AMER. MACH.

Wanted—A position in a trade school, or in the mechanical department of some enginering school, or in some shop in charge of apprentices. Specialty, machine design and construction. "Entropy," 392, AM. MACH

MICHIGAN.

Wanted—Position as superintendent by a hustler. Systematic, but no red tape; good executive and mechanical ability in shop and foundry. Can make good. Box 382, AM. M.

NEW JERSEY.

Engineer, Draftsman (27) college training, 6 years experience internal combustion engines, compressors and staem, first-class firms, desires position, preferably on engineering staff or assistant. Box 385, AMERICAN MACH.

NEW YORK.

Competent mechnical draftsman, seeks position. Box 357, AMERICAN MACHINIST.

Mechanical draftsman wishes position. Valves. Address Box 399, AMER. MACH.

Automatic machine designer, chief draftsman. Six years in present position. Box 372, AMERICAN MACHINIST.

Business or Works Manager is open for high-class position in metal goods factory. Capable, 378, AMERICAN MACHINIST.

Superintendent, expert mechanic, thoroughly competent in every respect, desires change. Box 376, AMERICAN MACHINIST.

Mechanical draftsman, graduate, several years' experience as draftsman and designer, open for engagement. Box 400, AMER. MACH.

Man with long experience drop forging business, desires executive position. Superintendent or assistant. References. Box 347, AMERICAN MACHINIST.

Machine shop foreman or assistant superintendent (Westerner), technical graduate and familiar with modern shop practice. Box 388, AMERICAN MACHINIST.

Mechanical graduate, age 28, American (Westerner) experienced office, drafting and shop, good executive, desires a position where merit brings advancement. Box 383, AM. M.

General foreman, (36), responsible man, practical mechanic, successful in producing first-class work at satisfactory cost, varied experience, desires change. Box 354, AM. M.

Superintendent with 15 years practical experience desires change with company manufacturing steam engines or similar line. Aggressive and systematic and have produced results. Best of reasons for changing. Ready to take charge at once. If you are not satisfied with existing conditions in your shop, I can help you. Box 394, AMER. MACH.

Manager—Desires to change positions, locating in direct New York City vicinity. An exceptional man in line of business, office, departmental and factory re-organization. Thoroughly experienced, trained executive, tactful, discreet and loyal. My varied practical experience furnishes references of highest order. A result producer. Address, Webster 54 W. 107th st., New York City.

OHIO.

Machine shop foreman desires change. Can handle work and men to advantage, experienced on electrical machinery and general machine work; would accept road position. Box 353, AMERICAN MACHINIST.

PENNSYLVANIA.

Foreman pattern-maker, 14 years experience would like to make a change. Six years with present firm, young man, sober and with family. Box 359, AMERICAN MACH.

Wanted—To correspond with a firm in the machine and foundry business employing 500 or more men, who desire a superintendent with ability, health and character. Box 384, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Assistant Professor of Mechanical Engineering desires change. Ten years office and shop experience. Three years present position. Excellent reasons and references. Box 387, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Tool room foreman, must be able to design tools, jigs and fixtures for light accurate work. References required. Box 389, AMERICAN MACHINIST.

INDIANA.

Wanted—Manufacturing superintendent light machine manufacturer, good experienced man only need apply. Address R 310, AMERICAN MACHINIST.

IOWA.

Wanted—Three operators for screw machines in a Western city. State experience and kind of machines familiar with. Box 332, AMERICAN MACHINIST.

MARYLAND.

Wanted—An establishment making specialty of a very fine line of Power Transmission machinery wants two travelling salesmen. State age, married or single, experience, references and salary expected. Address Transmission, 398, AMERICAN MACHINIST.

MASSACHUSETTS.

Expert gear cutting man, also one young man for general office and shop assistant. Boston Gear Works, Boston, Mass.

Wanted—Lathe and planer hands. Also several new men just out of their time as improvers. Apply Mason Machine Works, Taunton, Mass.

Wanted—A man who thoroughly understands operation of Gould & Eberhardt gear cutters. Must be familiar with cutters and know how to turn out the maximum product of high-grade work. Address "B," 362, AM. M.

Wanted—Foremen of experience on medium weight, accurate work, to take charge

of planing and milling departments in up-to-date factory with modern equipment. Good positions for competent men. State age, experience, and wages desired. Box 367, AM. M.

MICHIGAN.

Wanted—Foremen for lathe and boring mill departments. Address General Superintendent, Olds Motor Works, Lansing, Mich.

Wanted—Immediately first-class die makers and machinists. Steady employment. Michigan Machinery Mfg. Co., Ypsilanti, Mich.

NEW JERSEY.

Wanted—Machinists, tool makers and turret lathe hands. Apply The Hall Signal Company, Garwood, N. J.

Draftsmen—We have positions now open for draftsmen. Call or address Henry R. Worthington, Harrison, N. J.

Wanted—First-class lathe and vise men for small steel work. Steady work, good pay, no trouble. Twenty-five miles from New York City. Box 194, AMERICAN MACHINIST.

Wanted—First-class die-makers on drawing, forming and blanking dies. Steady employment and good wages to good men. P. W. C., 397, AMERICAN MACHINIST.

Wanted—Young mechanic, familiar with setting automatic screw machines and small presses. Able to take good care of tools in general. P. W. C., 396, AMERICAN MACH.

Wanted—Several first-class tool makers on jigs and fixtures. Must be capable of setting up screw machines. Steady work; good wages; country town. Address M. L. Bayard & Co., Woodbine, N. J

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—By a firm near Newark, N. J., first-class mechanical draftsmen on electrical machinery, also a tool designer. None but experienced men wanted. State salary expected and how soon able to begin. Box 390, AM. M.

Wanted—A first-class hand on Pratt & Whitney automatic screw machines. A good place and steady work for the right man. Apply or send recommendations or references to Domestic Sewing Machine Co., Newark, N. J.

Wanted—Two or three thoroughly reliable and experienced draftsmen on tools and fixtures. This may prove a very unusual opportunity for the right man. Apply by letter only with copies of recommendations or names of references to Frederick M. Bush, Supt., 31 Halsey St., Newark, N. J.

NEW YORK.

Wanted—Experienced tool and gauge makers. Best wages paid for first-class men. Remington Arms Company, Ilion, N. Y.

Wanted—Die sinkers. Pay from $3.25 to $4.00 per diem. Apply to Board of Labor Employment, Navy Yard, Brooklyn, N. Y.

Wanted—Expert draftsmen: designers on a line of dies, jigs, fixtures and shop tools for light, interchangeable work. Factory outside New York. Box 377, AMERICAN MACHINIST.

Wanted—In drafting room, young man with some knowledge of mechanical drafting. State age, experience, reference and salary expected. Address Box 381, AMERICAN MACH.

Wanted—Competent machinist to install high-speed engines in New York City and vicinity. Steady position to the right man. Watertown Engine Company, Watertown, N. Y.

Toolmakers—Wanted immediately, first-class toolmakers on high-grade dies, jigs, gauges and special fixtures for small machine manufacture. Send references to Drawer 7, Syracuse, N. Y.

Wanted—Mechanical draftsman with at least two or three years experience at detail work. Attractive salaries to good men. State age and experience. Address Box 366, AMERICAN MACHINIST.

Wanted—We have openings for a few electrical and mechanical draftsmen. State age, experience and salary expected. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—A young man mechanically inclined and with some office experience. Must be accurate and quick at figures. State age, experience, reference and salary expected. Address Box 380, AMERICAN MACHINIST.

Draftsman for details and general drawings in machine shop. Must be trustworthy, intelligent, a worker and familiar with patterns. State experience, age, references and pay expected. Box 395, AMERICAN MACH.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hour work day; time and half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

OHIO.

Wanted—Draftsman. One familiar with automomile work preferred. None but first-class draftsmen need apply. Box 340, AM. M.

Foreman wanted—To take entire charge of forging shop on general line of tool-steel and soft-steel forgings. Give age, experience, references, and salary expected. Address Box 375, AMERICAN MACHINIST.

Wanted—Foreman for body and running gear finishing and assembling department in large automobile works. Must have had previous experience in this line. Box 339, AMERICAN MACHINIST.

Wanted—Traveling salesman for southern territory by large manufacturer of small tools, located in middle West. State age and experience. Correspondence confidential. Address Box 393, AMERICAN MACHINIST.

Wanted—Foreman experienced in gas engine work to take charge of engine assembling department in large automobile factory. Must be a hustler and come well recommended. Box 337, AMER. MACHINIST.

Wanted—Foreman to take charge of repair department in automobile factory. Must have had experience with high-grade American and foreign cars and be able to handle men to advantage. No others need apply. Box 338, AMERICAN MACHINIST.

Wanted—First-class man to take charge of designing of up-to-date jigs and fixtures for machine-tool work. Must be capable of giving instructions in use of the same. None but parties having practical shop experience need apply. State experience and salary wanted. Address Cincinnati Milling Machine Co., Cincinnati, O.

PENNSYLVANIA.

Wanted—First-class draftsman, familiar with paper-mill machinery. Box 331, AM. M.

Wanted—Lathe hands, experienced in heavy roughing work. Steady work at satisfactory wages. Apply Titusville Forge Co., Titusville, Pa.

Wanted—Several first-class scrapers, also planer and lathe hands, for machine tool work. Address, Colburn Machine Tool Company, Franklin, Pa.

Wanted—Foreman for foundry employing 25 to 75 men, making boiler and engine castings. State age, wages expected, married or single. Address, "Foreman," 345, AM. M.

Wanted—By an automobile concern at present engaged in the manufacture of pleasure cars, a chief engineer, experienced in this line of work, to undertake the design of commercial vehicles. Applicants must state age, experience, references and terms. Address Box 386, AMERICAN MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for Monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections, these qualifications carry most weight; character, common sense, experience with automatic machinery, (or) printing-office experience, or type foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis Plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Wanted—Experienced draftsman, one familiar with wood-working machinery preferred. Good opening with large and growing concern. Box 373, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Tool and jig workers and gas engine men good wages if competent. Witte Iron Works Company, Kansas City, Mo.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	146
Acme Machinery Co.	34
Adams Co.	116
Advance Mfg. Co.	174
Albro-Clem Elevator Co.	140
Alliance Machine Co.	142
Almond Mfg. Co. T. R.	153
Alteneder & Sons, Theo.	34
American Blower Co.	128
American Gas Furnace Co.	109
American Pulley Co.	134
American Tool Works Co.	8
American Tube & Stamping Co.	157
Armstrong Bros. Tool Co.,	114 and 177
American Watch Tool Co.	156
Athol Machine Co.	160
Atlas Machine Co.	177
Auburn Ball Bearing Co.	174
Audel & Co., Theo.	180
Automatic Machine Co.	133
Backus Water Motor Co.	162
Badger & Sons Co., E. B.	178
Baird Machinery Co.	177
Baker Machine Corp.	163
Baker Brothers	142 and 184
Baldwin Chain & Mfg. Co.	180
Baldwin Steel Co.	156
Barker & Co., Wm.	172
Barnes Co., B. F.	129
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E	109
Bath Grinder Co.	99
Baush Machine Tool Co.	190
Bay State Stamping Co.	172
Bay State Tap and Die Co.	138
Beaman & Smith Co.	15 and 148
Becker-Brainard Milling Machine Co.	23
Bemis & Call Hardware & Tool Co.	147
Bertram & Sons Co., John	33
Bertsch & Co.	140
Besly & Co., Chas. H.	127
Bethlehem Fdry. & Mach. Co.	146
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	179
Bilgram, Hugo	34
Billings & Spencer Co.	180
Binsse Mach. Co.	34 and 119
Birdsboro Steel Fdry. & Machine Co.	26
Blaisdell Machinery Co.	136
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	182
Boker & Co., Hermann	89
Boston Gear Works	138
Boynton & Plummer	131
Bowers, E. J.	164
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	131
Brickner Machine Co.	178
Bridgeport Safety Emery Wheel Co.	147
Bristol Co.	4th cover
Brown-Cochran Co.	162
Brown Hoisting Mach. Co.	143
Brown & Co., R. H.	148
Brown & Sharpe Mfg. Co.	4th cover and 79
Buckeye Engine Co.	154
Buffalo Forge Co.	4th cover
Builders Iron Fdry.	3rd cover
Bullard Auto. Wrench Co.	193
Bullard Machine Tool Co.	32
Burke Machinery Co.	132
Burr & Sons, Jno. T.	180
Bury Compressor Co.	136
Butler, A. G.	146
Byram & Co., Inc.	164
Caldwell & Son Co., H. W.	135
Carborundum Co.	26
Card Mfg. Co., S. W.	20
Carpenter Tap & Die Co., J. M.	187
Case Mfg. Co.	142 and 178
C & C Electric Co.	171
Chadwick & Co., G. B.	160
Chambersburg Engr. Co.	175
Chattanooga Machinery Co.	148
Chicago Flexible Shaft Co.	108
Chicago Rawhide Mfg. Co.	140
Chisholm & Moore Mfg. Co.	142
Cincinnati Electrical Tool Co.	184
Cincinnati Machine Tool Co.	135
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	27
Cincinnati Shaper Co.	194
Clark Cast Steel Cement Co.	165
Clayton Air Compressor Wks.	136
Cleveland Automatic Mch. Co.	18
Cleveland Cap Screw Co.	157
Cleveland Crane & Car Co.	142
Cleveland Fillet Co.	179
Cleveland Planer Works	123
Cleveland Twist Drill Co.,	4th cover and 101
Cleveland Wire Spring Co.	182
Cling-Surface Co.	163
Clough, R. M.	175
Coates Clipper Mfg. Co.	112
Cochrane-Bly Co.	114
Coes Wrench Co.	28 and 29
Colburn Machine Tool Co.	22
Columbus Machine Co.	162
Cook Co., Asa S.	142
Crescent Forgings Co.	184
Cresson Co., Geo. V.	154
Crocker-Wheeler Co.	171
Crowe Name Plate & Engraving Co.	175
Cullman Wheel Co.	140
Cumberland Steel Co.	178
Curtis & Co. Mfg. Co.	136
Curtis & Curtis Co.	180
Cushman Chuck Co.	148
Davis, Rodney	138
Davis Machine Co., W. P.	106 and 176
Dayton Machine & Tool Wks.	147

PAGE

Dayton Pneumatic Tool Co..136
Desmond-Stephan Mfg. Co....146
Detrick & Harvey Mach. Co.. 95
Dexter, Chas. S.....175
Diamond Chain & Mfg. Co...137
Diamond Machine Co...3rd cover
Dickinson, Thos. L.....164
Diehl Mfg. Co.....172
Drucklieb, C. 136
Dixon Crucible Co., Joseph...134
Dodge & Day 146
D'Olier, Jr., Co., Henry..... 95
Dreses Machine Tool Co.....188
Drucklieb, C. 136
Durbrow & Hearne Mfg. Co...154

Earle Gear & Mach. Co.....140
Eastern Machinery Co.....178
Eberhardt Bros. Machine Co.140
Eck Dynamo & Motor Works.172
Elliott Chemical Works.....165
Emmert Mfg. Co.....160
Equipoise Rivet Co.....174
Errington, F. A. 149
Estep & Dolan 164
Evans Friction Cone Co.....174
Excelsior Needle Co. 102

Fairbanks Co. .....129 and 177
Farrel Fdry. & Mach. Co.....157
Fawcus Mach. Co.....138
Fellows Gear Shaper Co.....141
Felton, Sibley & Co.....158
Fenn-Sadler Machine Co.....124
Firth Sterling Steel Co.....159
Fitchburg Machine Works.... 31
Foos Gas Engine Co.....162
Foote Bros. Gear & Machine Co. 140
Foote, Burt & Co....173 and 185
Fosdick Machine Tool Co..... 16
Franklin Portable Crane & Hoist Co. 145
Franklin Mfg. Co., H. H..... 96
Frasse & Co., Peter A.....180
Frevert Machinery Co.....142
Fuchs & Lang Mfg. Co.....158

Gang Co., Wm. E.....174
Ganschow, Wm. 140
Garden City Fan Co.....172
Gardner Engineering Co.....175
Gardner Machine Co.....146
Garvin Machine Co..... 94
Gem Mfg. Co.....129
General Electric Co.....166
General Pneumatic Tool Co..143
Geometric Tool Co..... 23
Gisholt Machine Co..... 24
Gleason Works .....4th cover
Globe Machine & Stamping Co. 165
Goldschmidt Thermit Co.....158
Goodell Pratt Co....152 and 178
Goodson Electric Ignition Co.162
Gorton Machine Co., Geo.....132
Gould & Eberhardt.....111
Graham Mfg. Co.....163
Grant Gear Works.....138
Gray Co., G. A. 163
Greaves, Klusman & Co.....175
Greendale Gas Engine Co....162
Greenfield Machine Co.....104
Greenfield Steam Engine Wks.178
Greenwald Co., I. & E.....138

Hamlin, Geo. R.....174
Hammacher, Schlemmer & Co. 85
Hamelle, Henry 180
Hampden Corundum Wheel Co. 182
Hardinge Bros. 144
Harrington Son & Co., Edw..188
Harrison, H. K. 162
Hart Mfg. Co.....125
Hartford Steam Boiler Insp. & Ins. Co. 162
Heald Machine Co.....181
Heller Bros. Co.....158
Hendey Machine Co..... 87
Henley Publishing Co., N. W. 95
Henry & Wright Mfg. Co.....189
Heppenstall Forge & Knife Co. 174
Hess-Bright Mfg. Co.....128
High Duty Saw & Tool Co., Eddystone, Pa. 83

PAGE

Hill, Clarke & Co.....177
Hisey-Wolf Machine Co..... 91
Hoefer Mfg. Co.....133
Hopkinson Machine Works...163
Horsburgh & Scott Co..4th cover
Horton & Son Co., E.....148
Howard Iron Works.....179
Howson & Howson.....174
Hunt Co., C. W.....142
Hunt & Co., Robt. W.....174
Hurlbut-Rogers Machine Co..113
Hyatt Roller Bearing Co.....175

Independent Pneu. Tool Co..173
Ingersoll Milling Machine Co.130
Ingersoll-Rand Co.....137
International Correspondence Schools 123
International High-Speed Steel Co. 158
International Specialty Co...146
Iroquois Machine Co.....146

Jacobs Mfg. Co.....150 and 151
Jacobson Mach. Mfg. Co....162
James, D. O.....138
Jantz & Leist Electric Co....172
Jeffrey Mfg. Co., The.....176
Jenkins Brothers 164
Johnson Machine Co., Carlyle121
Jones & Co., B M.....158
Jones & Lamson Machine Co. 12, 13 and 34

Keep, W. J. 158
Kelly Co., R. A.....113
Kelly, P. J. 176
Kempsmith Mfg. Co..... 93
Kent & Co., Edwin R.....159
Keuffel & Esser Co.....154
King Machine Tool Co.....178
Knecht Bros. Co.....132

Lang Co., G. R.....174
Landis Machine Co.....140
Landis Tool Co..... 81
Lapointe Machine Tool Co....160
LeBlond Machine Tool Co., R. K....4th cover, 31 and 119
LeCount, Wm. G.....148
Link-Belt Engineering Co....181
Lodge & Shipley Machine Tool Co. 4
Long & Allstatter Co., The...145
Lucas Machine Tool Co.....120
Lunkenheimer Co., The.....164
Lufkin Rule Co.....161
Lyon Metallic Mfg. Co.....183

Main Belting Co.....128
Marchant, Geo. F.....154
Maris Bros. 142
Marshall & Huschart Mch. Co. 177
Marston & Co., J. M.....178
Massachusetts Saw Works...121
Massachusetts Tool Co.....156
Matchless Cigar Lighter Mfg. Co. 140
Mathews, Hugh.....162
McCabe, J. J.....163 and 176
McGeorge Mfg. Co.....185
Mechanics Machine Co.....134
Merrell Mfg. Co.....180
Merrill Bros. 178
Merritt & Co. 178
Miami Valley Machine Tool Co. 120
Mietz, A. 162
Miner & Peck Mfg. Co.....162
Modern Machinery Daily News 186
Modern Tool Co.....148
Moline Tool Co.....135
Montgomery & Co. 122
Moore Co., Franklin.....144
Morris Foundry Co., John B.. 15
Morse Chain Co..... 99
Morse Twist Drill & Machine Co. 33
Morton & Co., B. K.....158
Morton Mfg. Co.....172
Motch & Merryweather Mch. Co. 177
Mueller Machine Tool Co....115
Mumford Co., E. H.....130
Mutual Machine Co.....172

National Acme Mfg. Co.....194

PAGE

National Corundum Wheel Co.146
National Machinery Co.....118
National Machine Co.....160
National Separator and Mach. Co. 165
Nazel Engineering & Machine Works 175
Neptune Mfg. Co.....180
New Britain Machine Co.....186
New Era Gas Engine Co.....162
New Era Mfg. Co.....164
New Haven Mfg. Co.....111
New Machine Co.....175
New Process Raw Hide Co..139
Newton Machine Tool Works. 11
New York School of Automobile Engineers 180
Niagara Machine & Tool Wks.125
Nicholson File Co..... 17
Nicholson & Co., W. H.....117
Niles-Bement-Pond Company 176, 195, 196, 197 and 198
Nolte Brass Co.....164
Northern Electrical Mfg. Co..167
Northern Engineering Works.142
Norton Emery Wheel Co.....103
Norton Grinding Co..... 30
Nuttall Co., R. D.....138
Nutter, Barnes & Co.....126

Obermayer Co., S. 165
O. K. Tool Holder Co.....177
Olds Gas Power Co.....162
Oneida Natl. Chuck Co.....148
Owen Machine Tool Co..... 22

Parker Co., Chas.....161
Patterson, Gottfried & Hunter, Ltd. 182
Patterson Tool & Supply Co..131
Pawling & Harnischfeger.....142
Paxson Co., J. W.....140
Philadelphia Bourse.....134
Philadelphia Gear Works.....138
Phillips-Laffitte Co.....175
Phoenix Iron Works Corp...129
Phosphor Bronze Smelting Co., Ltd. 165
Pike Mfg. Co.....191
Poole Co., J. Morton.....112
Potter & Johnston Mach. Co. 87
Pratt Chuck Co.....149
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co., 176 and 189

Ransom Mfg. Co.....146
Reece Co., E. F.....140
Reed Mfg. Co. 160
Reeves Pulley Co..... 22
Reisner Mfg. Co., W. H.....186
Reichhelm & Co., E. P., 4th cover
Rich, J. & G. 154
Ridgway Dynamo & Engine Co. 170
Risdon, S. A.....148
Rivett Dock Co.....3rd cover
Rivett Lathe Mfg. Co...3rd cover
Robbins, L. 127
Rockford Machine Tool Co., 33 and 187
Rockwood Mfg. Co.....132
Rogers & Hubbard Co.....158
Rogers Works, John M.....126
Roth Bros. Co.....171
Royersford Fdry. & Mach. Co.164
Rowbotom Machine Co.....124

Safety Emery Wheel Co.....144
Sames, C. M. 172
Saunders Sons, D. 174
Sawyer Gear Works.....138
Schacht Mfg. Co.....154
Schieren & Co., Chas. A.....107
Schumacher & Boye 9
Schwerdtle Stamp Co.....180
Scranton & Co.....163
Sebastian Lathe Co.....133
Sellers & Co., Wm. 21
Seneca Falls Mfg. Co.....125
Shaw & Co. 142
Shellenbach & Darling Tool Co.161
Shepard Lathe Co.....148
Shepherd & Parker.....174
Shultz Belting Co.....161
Sibley Machine Tool Co.....131
Simonds Mfg. Co.....140

PAGE

Skinner Chuck Co.....148
Sloan & Chace Mfg. Co..... 34
Slocomb Co., J. T.....116
Smith Co., E. G.....154
Smith & Mills 154
Speed Changing Pulley Co....128
Spicer Universal Joint Mfg. Co. 148
Sprague Electric Co.....169
Springfield Machine Tool Co.127
Standard Connecting Rod Co.163
Standard Engineering Works.179
Standard Gauge Steel Co....170
Standard Machinery Co.....179
Standard Roller Bearing Co..179
Standard Tool Co.....110
Standard Welding Co.....126
Stanley G. I. Elec. Mfg. Co...170
Star Corundum Wheel Co....147
Stark Tool Co.....136
Starrett Co., L. S.....155
Steffey Mfg. Co.....162
Steptoe Shaper Co., John.... 1
Stevens, F. B.....165
Stoever Foundry & Mfg. Co...179
Stow Mfg. Co.....171
Straley & Hasbrouck 174
Struthers-Wells Co.....162
Sturtevant Co., B. F..... 27
Swaine Co., Fred J.....184
Switchboard Equipment Co...168
Syracuse Twist Drill Co.....154

Tabor Mfg. Co.....130
Taylor-Wilson Mfg. Co.....141
Thompson Grinder Co.....180
Three Rivers Tool Co.....132
Tilghman-Brooksbank Sand Blast Co. 136
Toledo Machine & Tool Co....172
Toomey, Frank.....176 and 180
Triumph Electric Co.....168
Trump Brothers Machine Co..174
Tulley & Co., Henry C.....172
Turley, H. G.....138
Turner Brass Works.....175

Union Twist Drill Co..... 85
United Eng. & Foundry Co...117
U. S. Watch Tool Co.....154
Universal Drafting Machine Co. 155

VanDorn & Dutton Co.....138
Vandyck Churchill Co.....185
Vitrified Wheel Co. 174
Von Wyck Machine Tool Co..118

Walcott & Son, Geo. D.....190
Wallace Supply Co.....164
Waltham Machine Works.....142
Waltham Watch Tool Co....175
Ward & Sons, Edgar T., 158 and 185
Warner Instrument Co.....154
Warner & Swasey Co..... 83
Waterbury Farrel Foundry & Mach. Co. 130
Watson-Stillman Co. 100
Webster & Perks Tool Co.....109
Wells Bros. Co. 97
Wells & Son Co., F. E.....122
Westcott Chuck Co.....148
Western Tool & Mfg. Co....132
West Haven Mfg. Co., 4th cover and 133
Westinghouse Elec. & Mfg. Co.167
Westmacott Co., J. M.....148
Whatley, A. H.....175
Whitcomb-Blaisdell Machine Tool Co. 19
Whitman & Barnes Mfg. Co..105
Whitney Mfg. Co..... 77
Whiton Mach. Co., D. E.....149
Wiley & Russell Mfg. Co.....186
Wiley & Sons, John..... 34
Williamson Mfg. Co.....160
Wilmarth & Morman Co.....124
Windsor Machine Co.....115
Witteman & Co., A. P.....108
Wood's Sons Co., T. B.....173
Woodward & Powell Planer Co. 110
Worcester Mach. Screw Co...142
Wormer Machinery Co., C. C.178
Wyman & Gordon Co..4th cover

Yale & Towne Mfg. Co.....145

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Star Corundum Wheel Co., Detroit, Mich.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alloy, Nickel

Baker & Co., Hermann, N. Y.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.

Arbor Presses—*Continued.*

Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cochrane-Bly. Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects

Dodge & Day, Philadelphia, Pa.

Auctioneers

Shaw & Co., New York.

Automatic Machinery

Matchless Cigar Lighter Mfg. Co., New York.
Natl. Machinery Co., Tiffin, Ohio.

Ball Bearings

See Roller Bearings

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Barrels, Tumbling
Globe Mach. & Stamping Co., Cleveland, O.

Bars, Boring
Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Eng. Works, Chas. F., Chicago, Ill.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Bars, Boring Cylinder
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing
Cling-Surface Co., Buffalo, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Shults Belting Co., St. Louis, Mo.

Belt Filler
Schieren & Co., Chas. A., New York.
Shults Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather
Davis Machine Co., W. P., Rochester, N. Y.
Main Belting Co., Phila., Pa.
Montgomery & Co., New York.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic
Niles-Bement-Pond Co., New York.
Swaine Co., Fred J., St. Louis, Mo.
Watson-Stillman Co., New York.

Bending Machines, Power
Bertsch & Co., Cambridge City, Ind.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Natl. Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Swaine Co., Fred J., St. Louis, Mo.

Bending Tools, Hand
Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Bicycle Parts
andard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain
See Hoists. Hand.

Blowers
American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines
Buckeye Engine Co., Salem, O.
General Electric Co., New York.
Keuffel & Esser Co., New York.

Boilers
Davis Machine Co., W. P., Rochester, N. Y.
Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery
Acme Machy. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., Easthampton, Conn.
Davis Machine Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Foote, Burt & Co., Cleveland, O.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Lang Co., G. R., Cincinnati, O.
Natl. Machinery Co., Tiffin, O.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros., Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case-Hardening
Rogers & Hubbard Co., Middleton, Conn.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Tulley & Co., Henry C., St. Louis, Mo.
Wiley & Sons, Jno., New York.

Boosters
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co, New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks., Co., Cin., O.
Baker Bros., Toledo O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.

Boring and Turning Mills —*Continued.*
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, Ohio.
Lyon Metallic Mfg. Co., Chicago, Ill.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Brazing Plates
Phillips-Laffitte Co., Phila., Pa.

Broaching Machines
Burr & Sons, John T., Brooklyn, N. Y.

Bulldozers
Natl. Machinery Co., Tiffin, Ohio.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, Ohio.

Burners, Oil
Tate, Jones & Co., Pittsburg, Pa.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Montgomery & Co., New York.

Calipers
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Mass. Tool Co., Greenfield, Mass.
Montgomery & Co., New York.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Phila., Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fuchs & Lang Mfg. Co., New York.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S Foundry & Sales Co., South Norwalk, Conn.

Castings, Motor
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Phila., Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.
Witteman & Co., A. P., Philadelphia, Pa.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Natl. Machine Co., Hartford, Conn.

Centering Machines —*Continued.*
Phoenix Mfg. Co., Hartford Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Baisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford Conn.
Modern Tool Co., Erie, Pa.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Oneida Nalt. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Davis Machine Co., W. P., Rochester, N. Y.
Gisholt Mach. Co., Madison, Wis.
Horton & Son, Co., The E., Windsor Locks, Conn.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Westcott Chuck Co., Oneida, N. Y.

CHAIN DEPARTMENT

Roller Chains Block Chains
"Wizard" Chains.

MACHINE DEPARTMENT

Hand and Weight (feed) Milling Machines,
20-inch Water Tool Grinders.

MISCELLANEOUS DEPARTMENT.

Keys and Cutters for the Woodruff Patent System of Keying
"Presto" Chucks, Collets and Friction Tapping Devices
Sprockets for "Wizard" Chains
Hartford Printer.

"Presto" Chucks, Collets and Friction Tapping Devices are used in Drill Presses, Turret Machines and Lathes and they make possible the rapid change of Drills, Reamers, Counterbores, Taps, etc., without stopping the spindle of the machine.

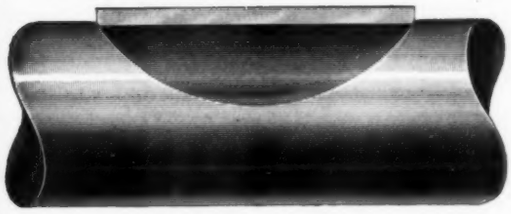
Patented

Detachable Type

Patented

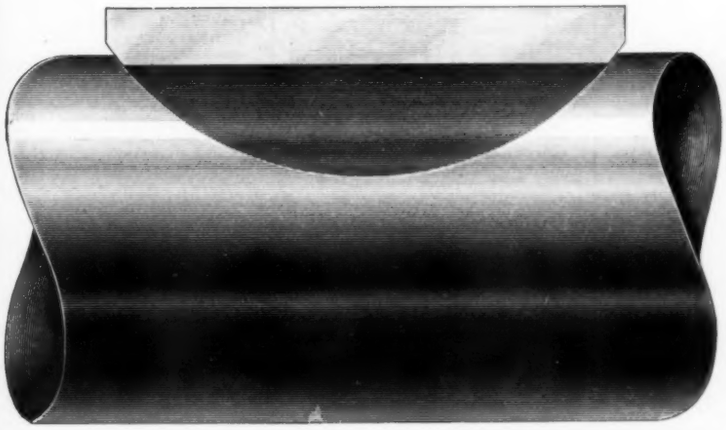
Against claims made by Competitors, we submit the following list ot Motor Car Manufacturers using "WHITNEY" ROLLER CHAINS and STANDARDS. Is it not time for everyone to admit that "WHITNEY" STANDARDS for ROLLER CHAIN dimensions are now the American Standards?

"ADAMS-FARWELL" "AMERICAN MOTOR TRUCK" "AUTO-CAR EQUIPMENT" "BAKER" "BERKSHIRE" "BIDDLE-MURRAY" "CADILLAC" "COLUMBIA" "CHAMPION (McCrea)" "CROWN" "CRAWFORD" "COLUMBUS BUGGY CO." "ELWELL-PARKER" "FORD" "FRANKLIN" "GAETH" "GALE" "GROUT" "HEWITT" "THE HOLMES" "IROQUOIS IRON WORKS" "LAMBERT" "KNOX" "MATHESON" "MACK BROTHERS" "MITCHELL" "MOLINE" "OLDS" "PACKARD" "RAMBLER" "RAPID" "REO" "STEARNS" "THOMAS" "TOURIST" "VECHICLE-EQUIPMENT" "WAYNE" "WESTERN MOTOR TRUCK" "WINDSOR," etc.



The "Woodruff" System is more mechanical, more efficient, and also a great Labor Saver.

The "WOODRUFF" Patent System of Keying



has been adopted by the Leading Manufacturers of Machinery, Automobiles, etc.

THE
WHITNEY MFG. CO.
Hartford, Conn., U. S. A.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Reed Mfg. Co., Erie, Pa.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., N. Y.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery

Link-Belt Engineering Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleve., O.

Compounds, Boiler

Advance Mfg. Co., Kalamazoo, Mich.

Compounds, Pipe Joint

Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air

Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Fulmer, Chas. F., Plainfield, N. J.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mietz, August, New York.

Compressors, Gas

Ingersoll-Rand Co., New York.

Condensers

Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior

Sprague Elec. Co., New York.

Cones, Friction

Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor

Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools

See Schools, Correspondence.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery

Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.

Countershafts, Friction

Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels

Franklin Mfg. Co., Syracuse, N. Y

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cresson Co., Geo V., Phila., Pa.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter Ltd., New York.

Couplings, Shaft—*Continued.*

Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes

Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable

Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machine

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.
Witteman & Co., A. P., Phila., Pa.

Crucibles

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa

Cupolas, and Ladles, Foundry

Byram & Co., Inc., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

Cut Meters

Warner Instrument Co., Beloit, Wis.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Globe Mche. & Stamping Co., Cleveland, Ohio.
Kent & Co., Edwin R., Chicago, Ill.
Marchant, Geo. F., Chicago, Ill.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Swaine Co., Fred J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, O.

Dies, Sub-Press

Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Foote, Burt & Co., Cleveland, Ohio.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Drawing Boards and Tables

Keuffel & Esser Co., New York.
Obermayer Co., S., Cincinnati, O.
Queen & Co., Phila., Pa.
Rich, J. & G., Phila., Pa.

Drawing Materials

Alteneder & Sons, Theo., Phila., Pa.
Keuffel & Esser Co., New York.
Neptune Mfg. Co., Needham, Mass.
Queen & Co., Phila., Pa.
Rich, J. & G., Phila., Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., B F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Natl. Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

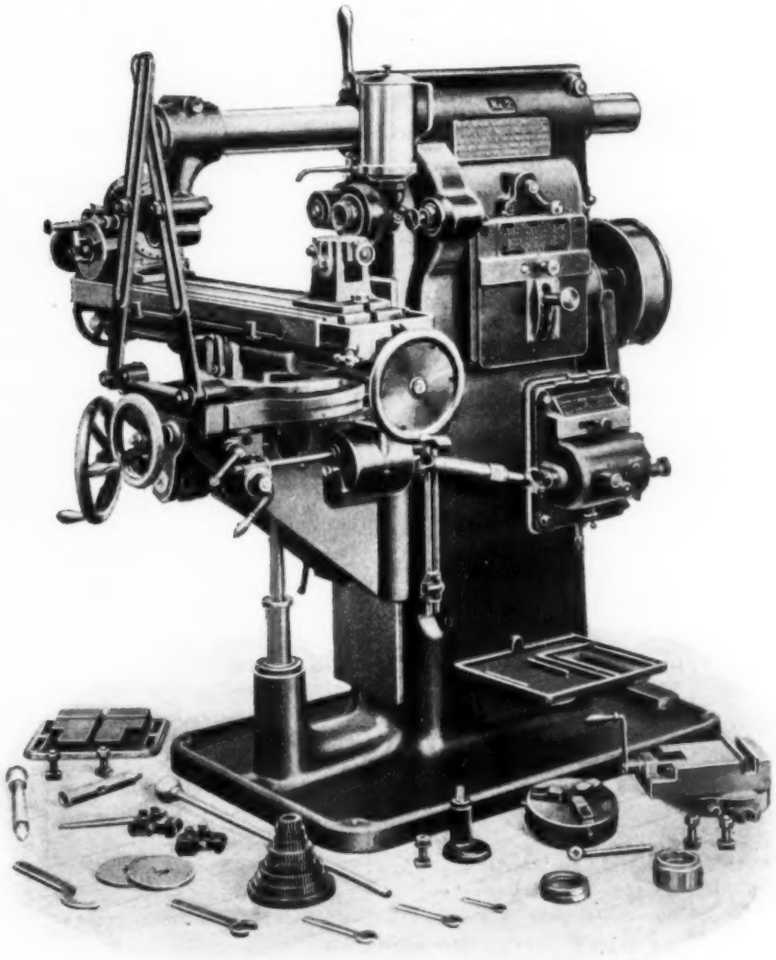
BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.

Simplicity of Operation

is seen in the Arrangement of the Working Parts of a

B. & S. UNIVERSAL MILLING MACHINE.



Hand wheels and levers for controlling the feeds are conveniently placed, insuring ease of manipulation.

Means for taking up the wear of the bearing surfaces are easily accessible.

The feed box presents no complicated mechanism, and the feeds are efficiently controlled by index slide and levers.

The overhanging arm is rigidly clamped with one lever.

WRITE FOR THE UNIVERSAL MILLING MACHINE PAMPHLET.

Drilling Machines, Radial
—*Continued.*
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Natl. Machine Co., Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent and Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.

Drills, Ratchet—*Continued.*
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I., Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
D'Olier & Co., H., Phila., Pa.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. Co., Chicago, Ill.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.

Emery Wheels
See Grinding Wheels

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Reed Mfg. Co., Erie, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.
Roedder, O. C., Karlsruhe, Germany.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Bowers, E. J., Philadelphia, Pa.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Greendale Gas Engine Co., Worcester, Mass.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buckeye Engine Co., Salem, O.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Ill.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Extinguishers, Fire
Badger & Sons Co., E. B., Boston, Mass.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Heller Bros. Co., Newark, N. J.
Montgomery & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Cochrane-Bly. Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Fillets, Leather
Cleveland Fillet Co., Cleveland, Ohio.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Foreign Agencies
Hamelle, H., Paris, France.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Machinery Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Natl. Machinery Co., Tiffin, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Boker & Co., Hermann, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Witteman & Co., A. P., Philadelphia, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Byram & Co., Inc., Detroit, Mich.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling
American Gas Furnace Co., N. Y.

Furnaces, Forge
Witteman & Co., A. P., Philadelphia, Pa.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Tempering
Witteman & Co., A. P. Philadelphia, Pa.

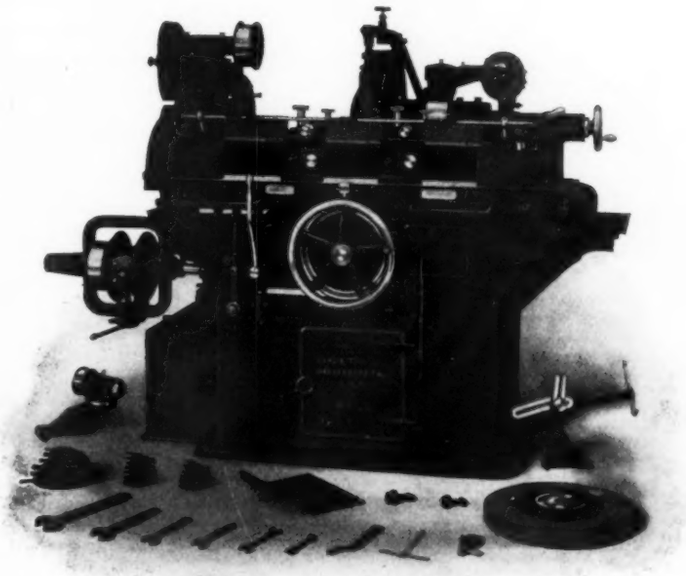
Furniture, Machine Shop
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

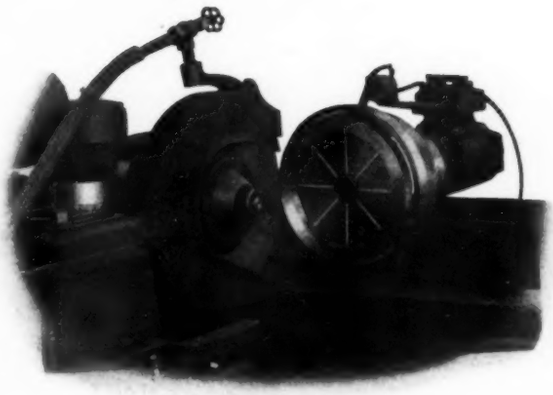
Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

A Sample.



Landis No. 22 Grinding Machine.



Magnetic Chuck.

Five Minutes for Each Piston.

Here are fifty-nine Automobile Gas Engine Pistons which were ground on the Landis No. 22 Plain Grinding Machine. They are 4½" diameter, 5½" long, $\frac{1}{32}$" diameter removed. Average time 5 minutes.

This is proof of what we are claiming for this No. 22, that it is the most profitable machine to be had for automobile manufacturers. It is especially adapted to the finishing of pistons.

In Landis plain machines the

Grinding Wheel Traverses,

not the work, which feature insures accuracy at points of reversing, constant lubrication of the ways which reduces wear to the minimum.

The geared headstock for driving the work and the instantaneous variable speed traverse device are commendable features.

Our Magnetic Chuck Headstock is specially adapted to grinding the sides of Piston Rings.

It is also suitable for all such work as grinding the sides of plates, saws, milling cutters, washers, etc. It is driven by a feed pulley on the spindle which is located back of chuck next to bearing in headstock. We are particularly anxious to get in communication with automobile builders for we know that we have the grinding machines that best meet their requirements. Landis machines are not only very rapid producers, but they are accurate to a quarter of one-thousandth inch.

Landis Tool Company, Waynesboro, Pa., U.S.A.

AGENTS—W. E. Flanders, 309 Schofield Building, Cleveland, Ohio, and 933 Monadnock Blk., Chicago, Ill. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Gages, Steam

Davis Machine Co., W. P., Rochester, N. Y.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Matchless Cigar Lighter Mfg. Co., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sloan & Chace Mfg. Co., Newark, N. J.
Turley, Harvey G., St. Louis, Mo.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
James, D. O., Chicago, Ill.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Mfg. Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Turley, Harvey G., St. Louis, Mo.
VanDorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide

Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.

Gears, Rawhide—*Continued.*

Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., The, Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
James, D. O., Chicago, Ill.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
VanDorn & Dutton, Cleveland, O
Walcott & Son, Geo. D., Jackson Mich.

Generating Sets

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wisc.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.
VanDorn & Dutton, Cleveland, Ohio.
Walcott & Son, Geo. D., Jackson, Mich.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S. Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Rivett-Dock Co. Boston, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Machine & Tool Works, Dayton, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., New York.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Cylindrical

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.

Grinders, Cylindrical—*Continued.*

Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Thompson Grinder Co., Springfield, O.

Grinders, Drill

Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.

Grinders, Internal—*Con't.*

Heald Mch. Co., Worcester, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring

Heald Mach. Co., Worcester, Mass.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines

Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.

Grinding and Polishing Machines—*Continued.*

Coates Clipper Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneumatic Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Natl. Machine Co., Hartford, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, Ohio.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Royersford Fdry. & Machine Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Star Corundum Wheel Co., Detroit, Mich.
Stow Mfg. Co., Binghamton, New York.
Thompson Grinder Co., Springfield, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinding Wheels

Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, N. Y.
Safety Emery Wheel Co., Springfield, O.
Star Corundum Wheel Co., Detroit, Mich.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, O.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Pneu. Tool Co., Cleveland, O.
Dayton Pneumatic Tool Co., Dayton, Ohio

Automatic Multiple Punching Machine.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show a remarkable machine for punching the sheets and angles of structural iron work which is the recent product of Wm. Sellers & Co., of Philadelphia. In work of this class the plates of built up columns and girders, for example, require a a row of holes down each side for the rivets which secure them to channels or angles and numerous holes along their length for the attaching of brackets, braces, etc., and the laying out and punching of these holes involve much labor and lead to many mistakes. In the machine under description the layout is on a strip of punched paper which, while not a reduced model of the intended plate, is a key sheet by which the location of the holes in the plate is determined. The means by which the holes in the paper are made to determine the location of the holes in the plate are very similar in principle to the essential action of the Monotype. The punched strip of paper is fed through an appliance called a paper tower and compressed air blowing through the holes in the paper is made to determine which punches shall act and what the distance between successive rows of holes shall be. The machine is of great capacity, being able to handle plates 10 feet wide by 100 feet long and carrying 36 punches.

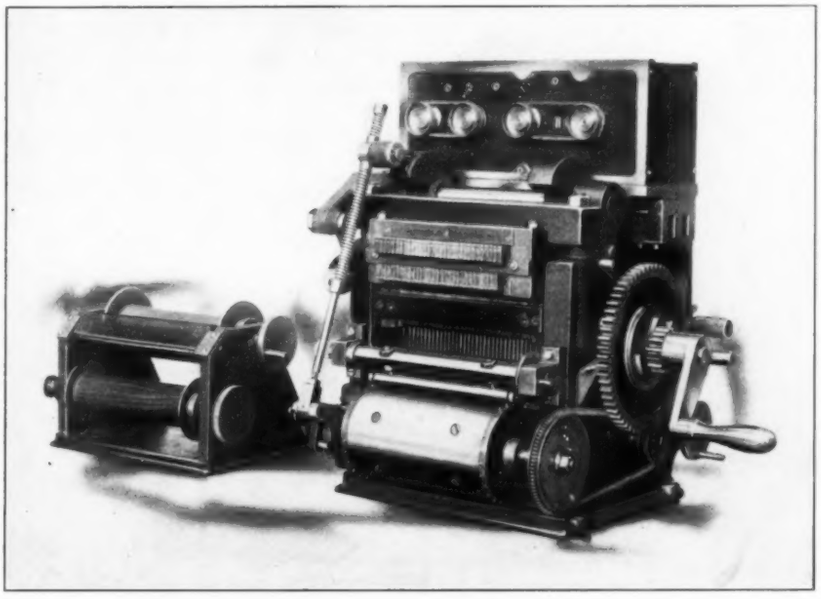


FIG. 1. KEYBOARD AND CHECKING MACHINE.

PUNCHING THE KEY SHEET OF PAPER.

The punching of the paper key strip is done in the drawing office on a machine called a keyboard and shown at the right in Fig. 1. The paper is fed through the machine by the spiked cylinder in front and, regardless of the spaces between successive rows of holes, advances by a fixed amount at each turn of the crank. Above the spiked drum are two rows of keys, part of which are numbered and relate to the punches which are to operate in a given row of holes, while the rest relate to the space between that row and the next. That is, the spacing across the sheet is determined by the location of the punches and by those which act in a given row of holes, while the spacing lengthwise is determined by the feed of the sheet.

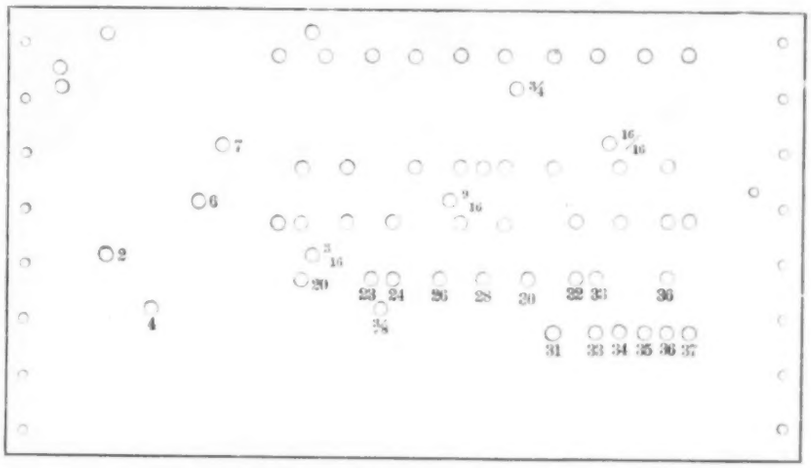


FIG. 2. SHORT SAMPLE OF A PUNCHED KEY SHEET.

By depressing the keys for the punches which are to operate, the machine is made to punch corresponding holes in the paper as shown by the lower row of numbered holes at the right of Fig. 2; which, however, is not a representation of an actual girder, but of a testing plate in which the layout is arbitrary and intended only to test the operation of the mechanism. The spacing keys are in two sets, one for whole inches and one for fractions, the latter giving any fractional spacing desired in sixteenths and the punching machine adding the whole inch and fractional indications. The punching of the paper for the lengthwise spacing is shown by two holes above and slightly to the left of those just described and marked 4 and ⅜ respectively. The hole marked 4 indicates a spacing of 4 inches to which the indication ⅜ is added, making a total spacing of 4⅜ inches. Above these holes is another pair of indications, those marked 20, 23, 24, 26, etc., indicating the numbers of the punches which are to act in the next row and those marked 2 and 3/16 showing that the next lengthwise spacing is to be 2 3/16 inches, and above these are other rows which do not need description. Should there be a considerable gap between rows of holes, the machine may obviously be made to make it by omitting indications for holes during the gap. The extreme possible feed of the machine is 8 inches and should desired rows of holes be further apart than this the feed is made in steps which aggregate the desired distance. An example of this is shown near the top of Fig. 2, where one pair of spacing indications calls for 7 16/16, that is, 8 inches; and next above these, without any punching indications between, is a further spacing indication of ¾ inch, showing that a total space of 8¾ inches is to be made in two steps.

At the top of the keyboard are four dials, of which the one at the left shows fractions, the next inches, and the last two feet; and when a key sheet is finished, the total spacing called for may be at once compared with the drawing of the plate to be punched, and any error in the sum of the spacings is at once detected.

Such a check is not, however, sufficient, as the key sheet once punched and placed in the punching machine, the latter can do nothing but blindly follow it, and means for detecting errors are thus essential. These are provided in the little

checking machine shown at the left in Fig. 1. By this the key sheet is drawn past a transparent scale whereby the meaning of each punched hole may be immediately read and compared with the structural drawing.

To avoid any possible misunderstanding it is well to point out again that the key sheet is not in any sense a reduced model of the work and that there is no multiplying of the scale of the key sheet to that of the punched plate. On the other hand, every indication of the key sheet is positive, each spacing hole having a direct meaning in the interpretation of which no error can be made by the punching machine. The key sheet directs the punching machine to make a given space and the accuracy of this space is dependent on the spacing mechanism of the punching machine and on nothing else.

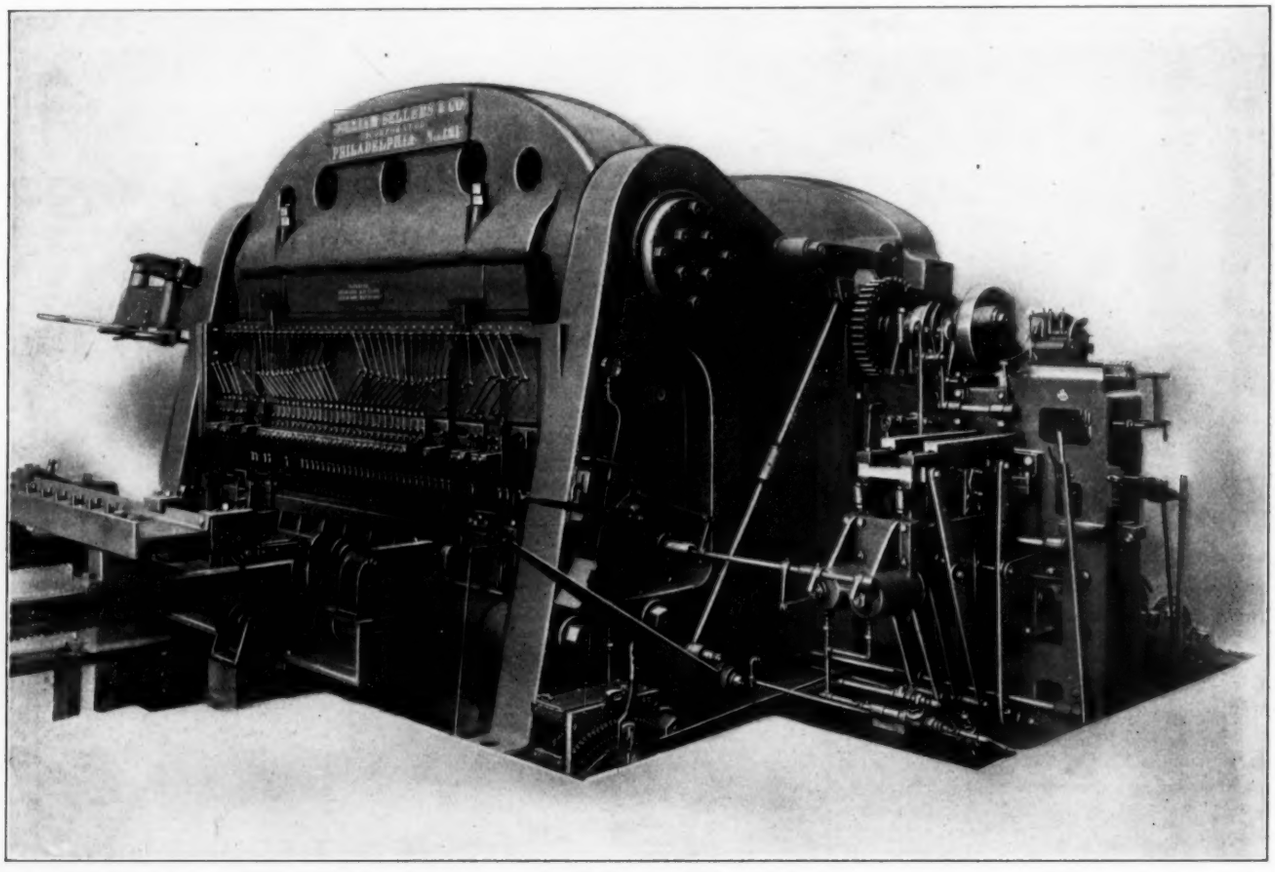


FIG. 3. FRONT SIDE OF A PUNCHING MACHINE.

THE PUNCHING MACHINE.

The punching machine is shown in Figs. 3 and 4. The row of punches will be seen in Fig. 3 with the jointed pipes by which compressed air is admitted to the punch controlling cylinders, the admission of compressed air to these pipes being controlled by the holes punched in the key strip of paper which is fed through the appliance at the top of the paper tower at the extreme right. At the extreme left is an I-beam lying flat and having grips for the end of the sheet to be punched. The I-beam is bolted to a pair of racks which extend through the machine and carry a second cross-beam at their further ends, to which that end of the sheet is clamped. The sheets being wide and stiff horizontally, there is no necessity for a guide for them other than that provided by their own stiffness and the guides for the racks. The length of the racks is such as to take in a sheet 100 feet long if necessary. When punching angles a side guide is necessary, as they are neither stiff nor straight, but the details of this are not shown.

Fig. 4 shows the rear side of the machine. The racks and paper tower will be recognized and at the left and bottom is the feeding and indexing mechanism, which is of an unusual degree of merit and interest.

THE PUNCH CONTROL.

Fig. 5 shows the details of the punch control, a punch being shown at *a*, the cross section of the ram at *b* and of a punch holder at *c*. It will be understood that the punches are adjustable lengthwise of the ram, and must be located with respect to the spacings across the sheet, the function of the compressed air control being merely to determine at a given stroke what punches shall act. The clamping bolts for the punch holder are shown at *d* and *e*. The punch has behind it a hardened steel plug *f* set in a block *g* which has a rod *h* connecting it to the air piston *i*. A spring behind the piston holds it, normally, at the left-hand end of its cylinder, in which position the plug *f* and block *g* clear the rear end of the punch and on the next descent of the ram that punch will simply rise in its holder and make no hole. Should, however, there be a hole in the key strip of paper for this punch, air will be admitted behind the piston *i* and push plug *f* behind the punch and on the descent of the ram this punch would act.

The control of the punches from the paper strip is not, however, direct, as the amount of air required to fill the punch-controlling cylinders is too great to pass through the small holes in the paper strip in the time available. A series of pilot or supplementary valves is therefore arranged—one valve for each punch—the air passing through the punched paper serving directly to trip the proper valves, which then admit an ample supply of air behind the punch-controlling plungers. The details of this bank of valves are not shown, but their location is seen in Figs. 3 and 4 on top of the paper tower each side of the paper drum apparatus.

THE PAPER DRUM.

The construction of the paper drum is shown in Fig. 6. The paper strip is shown at *a* and its reels at *b* and *c*. Between the reels is a rounded perforated shield *d* over which the paper is fed step by step by the spiked wheels at its ends

shown at *e* in the side view, where also are shown the perforations at *f*. The perforations are in two rows, one for the punch-indicating and one for the index-indicating holes in the paper. A leather-faced clamp *g* is automatically loosened while the paper is being shifted and tightened again after the movement is complete. The air supply to the clamp comes through its trunnions and is automatically shut off when the clamp is loosened. Obviously, after the paper is shifted and the clamp tightened the air finds its way through such holes as may be punched in the paper, the air passing through one set of holes determining which punches shall act and that passing through the other set doing the indexing, as will be described.

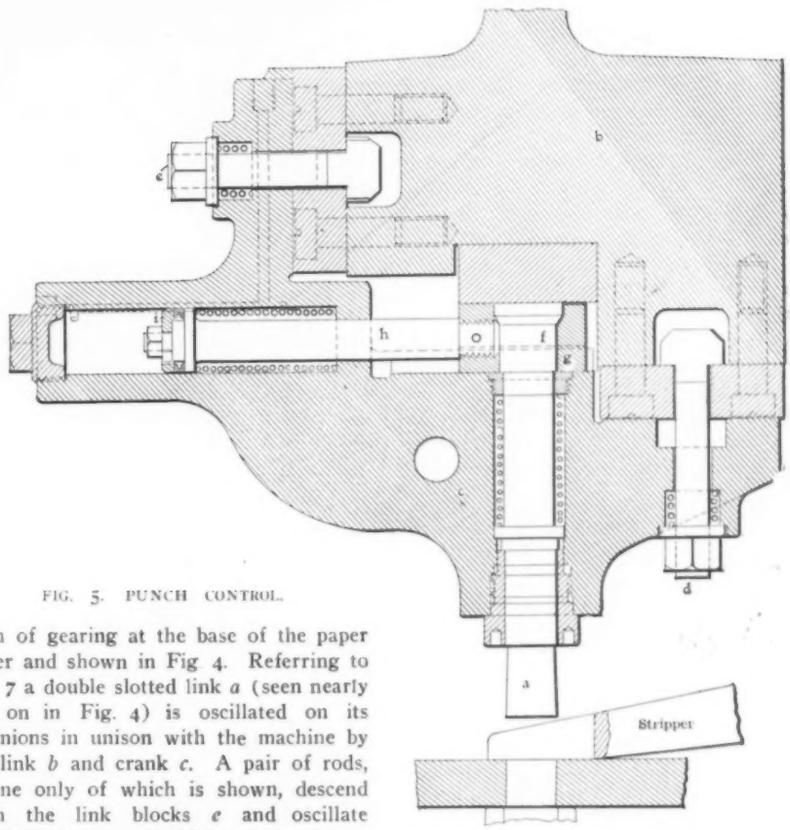


FIG. 5. PUNCH CONTROL.

THE INDEX MECHANISM.

The amount of air required to operate the spacing mechanism is much less than that required for the punch control and hence this mechanism has no pilot valves, the air for the index control passing directly through the perforations in the paper. In other respects the spacing mechanism is, however, much more intricate than the punching system, and nothing beyond its general outline will be presented.

The spacing mechanism is located on the paper tower and is shown in both Figs. 3 and 4 and more in detail in Fig. 7. The mechanism is in duplicate, one set for the whole inches and the other for the fractions, the two being added by a train of gearing at the base of the paper tower and shown in Fig 4. Referring to Fig. 7 a double slotted link *a* (seen nearly end on in Fig. 4) is oscillated on its trunnions in unison with the machine by the link *b* and crank *c*. A pair of rods, *d*, one only of which is shown, descend from the link blocks *e* and oscillate swinging levers, of which one is shown at *f* and each of which carry a pawl engaging with a ratchet of which both are shown at the base of Fig. 4. Of one ratchet a tooth represents a feed of one inch and of the other one-sixteenth of an inch. The number of notches engaged is obviously determined by the position of the link block *e* in the link *a* and this

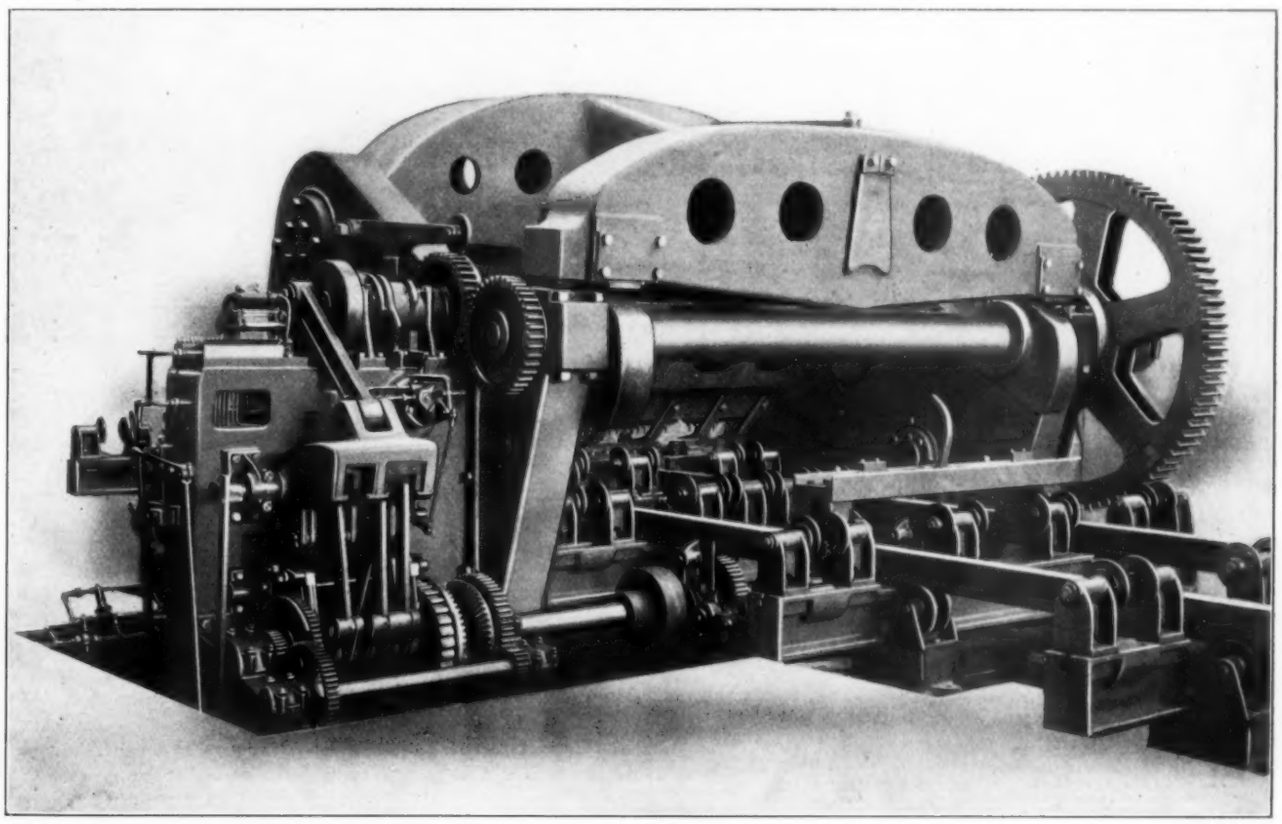


FIG. 4. REAR SIDE OF PUNCHING MACHINE.

position is determined by the holes in the paper strip.

To accomplish this a beautiful mechanism, originally designed by Wm. Sellers & Co. for a spacing punch (described at page 1053, Vol. 22), in which the spacing was determined by hand manipulation, is used. This mechanism was subsequently adopted in the monotype, with the addition of a system of air control, by which it is made automatic, and this feature has been adapted to the spacing control in the present machine.

A rod *g* connects an arm on link *a* with one of a pair of tong levers *h i*, an air piston *j* holding the fulcrum of tong *i* with retractible force in the position shown. The operation of rod *g* causes the tongs to alternately open and close, but so far as described the space between their upper ends when closed, while fixed in amount, is indeterminate in position. A series of air-operated plugs, indicated by dotted lines *k k k*, is connected with the paper tower and whatever spacing hole in the paper allows air to flow, the corresponding plug is depressed, thereby engaging one tong head and forcing the other to close up to it and thus locate the sliding block *l*, attached bar *m* and link block *e* and thus determine the number of index notches for the feed.

THE ADDING MECHANISM.

The two indexing mechanisms for whole inches and fractions are located side by side as shown in Figs. 3 and 4. The adding mechanism is shown at the base of the paper tower in Fig. 4 and more in detail in Fig. 8, which also shows an end elevation of the double slotted link at the top. The whole-inch ratchet *a* drives the bevel gear *b* directly, while the fractional ratchet *c* drives bevel gear *d* through a surrounding back gear as shown in Fig. 4. Gears *b* and *d* are two members of a jack-in-the-box of which the other gears are *e* and *f*, which are carried by the support *g*, which is keyed to shaft *h* by which the work-indexing racks are driven. The action of the jack-in-the-box is obviously to add the whole-inch and fractional indications together and carry the sum to shaft *h*.

The mechanism described is but the skeleton of the whole. Many of the undescribed features relate to safety devices, for it is obvious that in so highly organized a machine things may go wrong. For example, a defective sheet of paper with an initial hole in it might cause two index plugs to act at once and thus prevent the jaws of the tongs from closing. This would wreck the tong mechanism but for the air piston *j*, Fig. 7. This air cylinder does much more than this, however, for by means of its piston rod and the latch *n* it is made to stop the machine. A number of other things may happen, any one of which will stop the machine. Moreover, it is obvious that this stopping must not take place during an indexing movement, as that would lead to uncertainty, and possible error, when the machine is again started, and it is therefore provided that the stopping shall always take place either before the beginning or after the completion of the indexing. F. A. H.

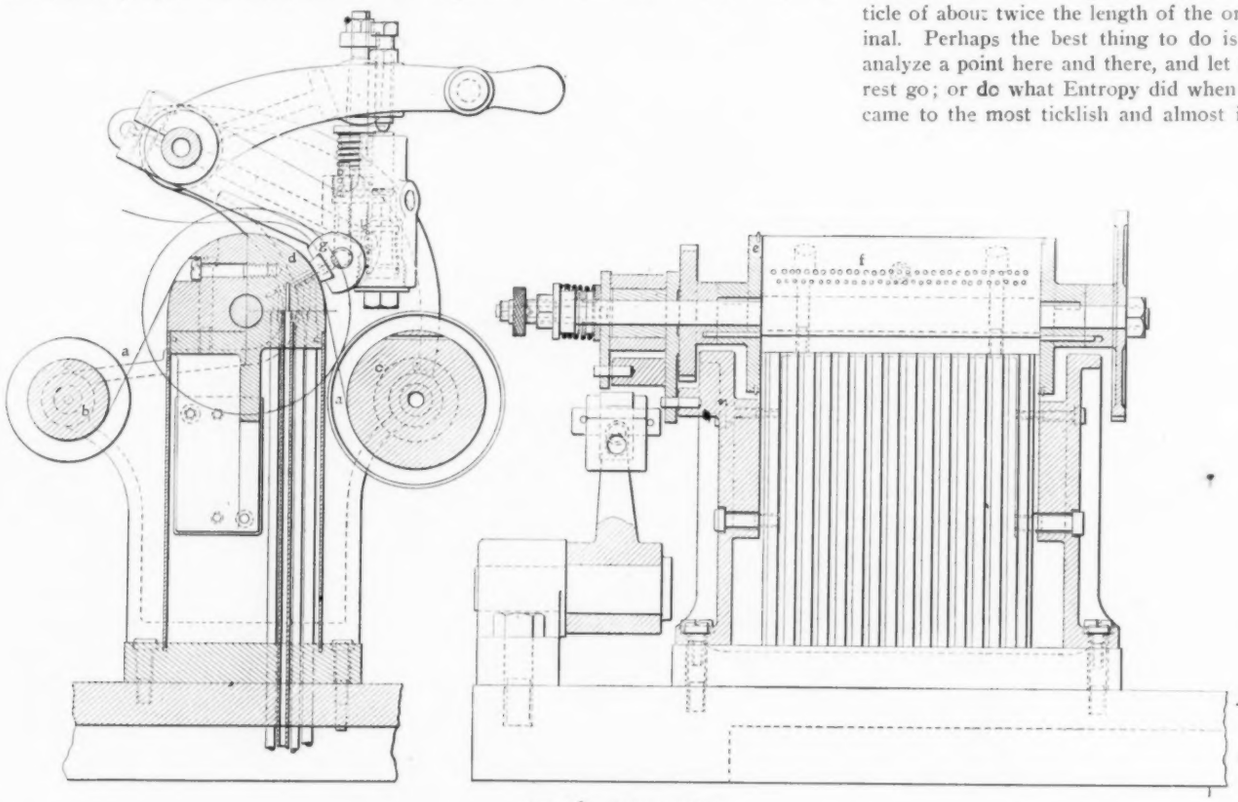


FIG. 6. PAPER DRUM.

Designing a Boring Mill.

BY A. L. DE LEEUW.

Entropy's article by the above name has been puzzling me. Did he mean to write a satire, or was it straight goods? Really, I cannot make it out. There are times when I hold to the one, and there are other times when I believe the other. Meanwhile there may be other persons equally benighted as your humble servant; and there may even be some young and unsophisticated person who believes in what Entropy said. To such innocent hearts I wish to say that Entropy's method (?) of designing a boring mill deserves the gold medal in a freak exhibition. To criticize his article requires another article of about twice the length of the original. Perhaps the best thing to do is to analyze a point here and there, and let the rest go; or do what Entropy did when he came to the most ticklish and almost impossible point of his design—"leave it to the imagination of the reader."

THE TABLE.

The first thing he considered was the diameter and thickness of the table. It was his first mistake, too. The first thing to consider after the size of the machine is its power. This holds good in any kind of machine tool, with the exception, perhaps, of tool grinders, etc. This thing of power is not often left to the designer to decide. It is a matter of business policy. Bullard has 10,000 pounds on full swing, and Gisholt has 9800, and Niles 9600, and Poole 10,400, etc.; so we ought to make it least 11,000 pounds. (The figures given are entirely fictitious and are in no way an indication of the relative powers of these various boring mills.) The president of the company and the various sales agents

do this part of the designing a good deal more than the designer.

However, Entropy begins with the table. He reasons that a 72-inch planer should have about a 60-inch table, and that a 72-inch boring mill should have a 60-inch table as well; for, he says, a planer is only a boring mill with an infinite radius of work. I fail completely to see any connection between reasoning and conclusion. He might just as well have said, "for the wind is northeast, and vivid red for a necktie looks good to me." There are some real reasons which determine the size of the table. One of them is that the table should be made as large as is practicable, and it remains then to be considered what is practicable. It should be as large as possible in order to give the maximum surface for supporting and clamping work; and another reason is that the driving gear should be as large as it can be made, so as to reduce the strain on the teeth, as well as the tendency to chatter. For this reason the size of the table on the smaller boring mills is generally the full swing of the machine. It is also very close to the full swing on very large mills, and especially on extension mills. For instance, the table of a 42-inch machine is generally made 42 inches in diameter. The table of a 16-foot mill is from 12 to 14, and in some cases even 16 feet in diameter, while a 16-foot extension mill is generally provided with a table 14 or 15 feet in diameter. It is only in the intermediate sizes that there is a marked difference in practice. This comes from the fact that some customers object, and with good reason, to having a table which does not allow the operator to get at his work without climbing on top of it. As this cannot be avoided with the larger mills, the common practice is to make the table nearly the full swing. As the operator is able to reach the center of the table anyhow, with the smaller mills, there, too, a full-size table is used; but on the mills above 72 inches and under 12 feet there is some room for discussion. I would have made the table about 66 inches in diameter, but I can understand that somebody else might wish to make it 72 or 60 inches. What I object to is the peculiar train of thought which Entropy tried to pass for reasoning, not his size of table.

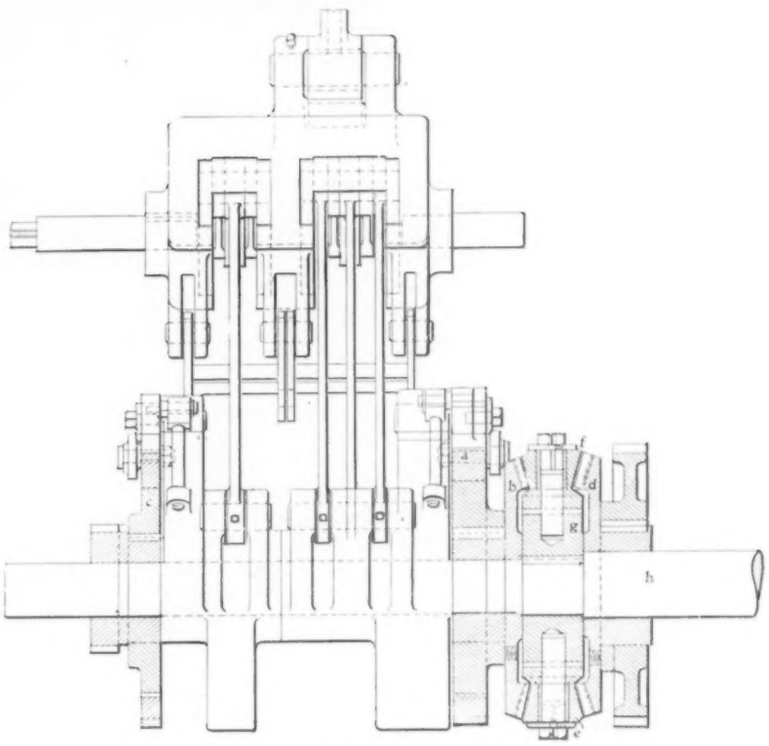


FIG. 8. THE ADDING MECHANISM.

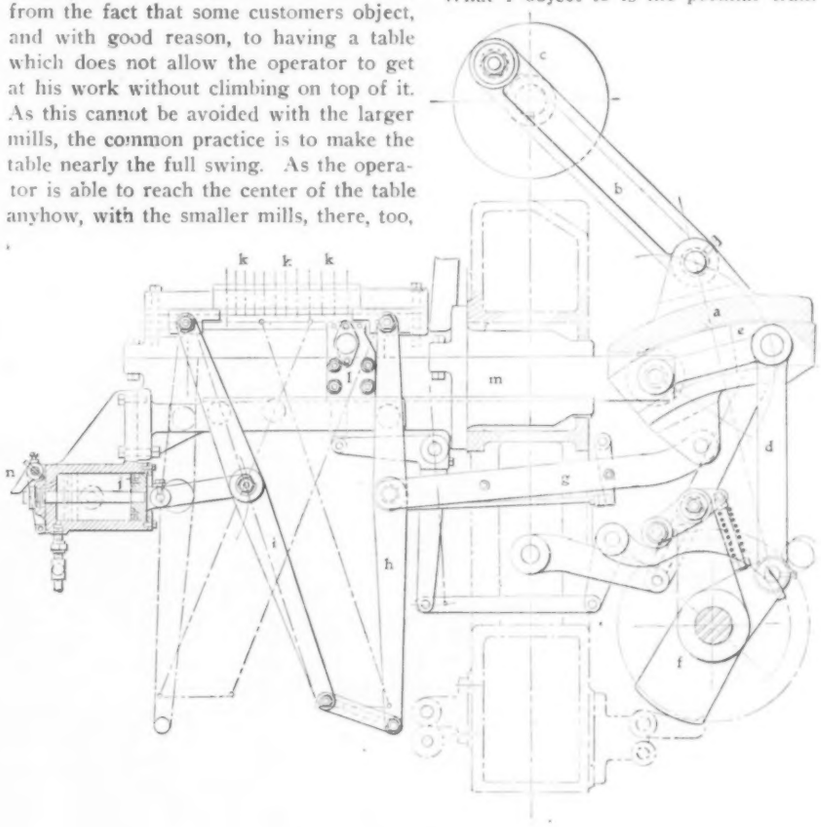


FIG. 7. THE INDEX MECHANISM.

THE MAIN GEAR.

His way of figuring the pitch of the main gear is truly wonderful. I would recommend the following method: First, have the president of the concern decide what the power of the mill shall be. He may ask your opinion, and attach a good deal of value to it; but, after all, he and the sales agents have to go up against what the competitor offers, and they must offer about as much or more. For instance, they decide to have the mill capable of taking two cuts in mild steel, each ½ inch deep, and with ⅛-inch feed (which makes ⅛ square inch of chip, only a trifle less than what Entropy mentions). Figuring on 115 tons pressure required for one square inch of chip removed (by the way, this is Entropy's figure, not mine), the pressure on full swing will have to be 28,000 pounds. As this pressure comes into play only when work of the full swing is operated upon, and as all the gearing is in play, it is only reasonable to deduct something for friction; but as this friction is rather an unknown quantity, it is safe not to deduct too much. We might call the pressure on full swing, say, 25,000 pounds. Figuring on a table of 60 inches in diameter, we may expect that the pitch diameter of the gear will be about 55 inches. (This may have to be corrected when we know a little more about the machine, but it is near enough for a first approximation.) The pressure on the pitch line of the main gear is then: $72/55 \times 25{,}000 = 33{,}000$ pounds. We can see at once that the pitch must be heavy,

and that, therefore, the pinion must be large. We will, therefore, limit the pinion to the smallest possible number of teeth. We will limit it to 15. Mark that I try to use the same figures as Entropy wherever possible, so as to give me a chance to compare all through the design. I prefer more teeth; 16 is better, 17 still better, and more is desirable. Less than 15 is not safe; not only on account of wear, but especially on account of smoother running. I have seen boring mills fail in this respect because the number of teeth in the main pinion was too small. The mere change to a larger number of teeth in this pinion would do away with all the chatter the mill had been subject to.

THE MAIN PINION.

The way Entropy arrives at the pitch and face of the main pinion beats even his way of getting at the size of the table. He might have followed the book method to some advantage. In that case he would have reasoned as follows: Let us assume 1½ diametral pitch for a first trial. This corresponds to about 2 inches circular pitch, and we may make the face about 6 inches (being three times the pitch, which is a good proportion where the gear is stiff and well supported). One might even use a somewhat wider face, if necessary. It all depends on circumstances. One of those circumstances is the way the gear is cut.

Entropy shows his gear and table in one piece. I would not recommend this construction. There are a number of good reasons against it. For instance, it makes it impossible to make the gear and table of different materials. In the case under consideration, for instance, it is almost imperative that the gear should be made of steel casting. Generally speaking, the gear should be made of harder and closer material than the table. Another point is that a break in the gear means a new table. Though it is right that the gear should be made strong enough for the work it is to do, yet it is impossible to foresee all that may happen. Something may work itself between gear and pinion or there may be a hidden blowhole in one of the teeth. Such a blowhole would have done no harm to the table, but is fatal to the gear. From the manufacturer's standpoint also the separate gear and table are preferable. The practical mechanic will readily understand this.

Coming back to the cutting of the gear, the most common and perhaps the most natural way is to cut it on the slotter. However stiff the slotter ram may be, there is a certain amount of deflection when the cut is taken, and this deflection is less at the top of the stroke than at the bottom, so that the tooth gap is not of an exactly even depth. To prevent bad running, it is customary, or at least it should be, to note how pinion and gear have been lying on the slotter table, and then to reverse one of the two on the boring mill, so as to have the pitch lines come together in all transverse sections of the gear. However, the unavoidable difference of material of gear and pinion makes it impossible to correct all error that way. The stiffness of the slotter then, puts a limit to the face of the gear. In short, conditions in the shop where the boring mill has to be built have to be taken into consideration, in the matter of the gear as well as in all other matters.

The Lewis formula shows that a 15-tooth pinion of 1½ diametral pitch and 6 inches face, and made of steel, will stand 18,800 pounds pressure. In our case, however, the pressure is 33,000 pounds, so that the pinion is not strong enough. I wish to remark here that, according to my experience, the Lewis formula should not be applied to the main driving gear of boring mills, and in general not where the load is steady and the speed low. It is perfectly safe to apply the formula, but I object to it because it is too safe. What I mean is this: When we attempt to bring the gear up to what the Lewis formula would require, we get a boring mill for which it would be hard to find a purchaser, on account of the high price. I have found it perfectly safe to add 25 per cent. to the value gotten by the formula. I have done this a great number of times and have never met failure. The way to get at it is to lay out gear and pinion and note the arc of contact, and take the worst position; then treat the gear teeth as beams loaded at one end and supported at the other. Adding 25 per cent. to 18,800 pounds makes 23,500 pounds. This is still insufficient. From a consideration of the method for finding the strength of the gear teeth, mentioned above, it will be seen that one way of strengthening the teeth would be to make them shorter. A careful outlay of the teeth shows that this can be done without interfering with the tooth action. Of course, special cutters are necessary, if the milling machine is used for either pinion or gear. I have used gears with dedendum of ¼ of the pitch, and they have given good satisfaction. Even this, however, will not bring the strength of the pinion up to what it ought to be. If our customer is not very "strenuous" in this respect, we let it go; otherwise I leave it to "the imagination of the reader," what ought to be done. As I am not designing a boring mill just now, but merely criticizing one, I'll take Entropy's figures under protest and go on.

Entropy finds the thickness of the table from a list of Brown & Sharpe cutters, which is one of the cleverest little tricks I have ever seen. What the cutter is going to do to the table is more than I know just now, for it is not customary to mill the T-slots in a boring-mill table. Not only that it would be a very awkward and costly operation to do it, but that it would be poor practice. One does not want to remove the scale from the bottom of the T-slots, as this scale adds much strength and permanence to the slot.

GENERAL CONDITIONS.

It seems that Entropy's boring mill was designed to meet the demands of one customer. This is rather peculiar, as the boring mill described has no special features. Ordinarily, a machine of this type is designed to fill the needs of the average customer, and still more often is merely a modification of another already existing. Once in a while it happens that, on account of changing conditions, or because competitors have been having the better of the fight, radical changes are made, or some new concern starts up and builds its boring mills to suit its own ideas. In either case, however, there should be a consultation between the powers of the different departments, and a conclusion should be reached as to what is going to be offered to the trade. It should never be forgotten that the main function of a boring mill, from the standpoint of the machine-tool maker, is not the turning and boring of pieces of work nor the making of chips, but the making of money. It is therefore of the greatest importance to determine beforehand how good the machine can be made, and still leave a margin of profit when sold at a price which compares favorably with the prices of competitors.

I presume then that the designer got his instructions as to the weight he was allowed to put into the machine. If so, then the first duty of the designer is to apportion this weight in a tentative way among the different parts of the machine; so much for the bed, so much for table and gear, so much for crossrail, so much for posts or housings, so much for heads and boring bars, so much for gearing, etc. He has to take something for a basis, for instance, a mill which has been built, or somebody else's mill. Of course, he should make corrections, and say, for instance, the table is too light, and so is the bed; therefore, he will first add enough to the weight of these parts in the old mill to bring them up to what they ought to be in the old design. Then he will again add to all the parts whatever is left and divide it proportionally. This does not give the final result, but is close enough to make a start. Entropy should have done some figuring of that sort, and not merely look up the size of the biggest cutter that is not going to be used to cut the T-slots. However, I'll take his table for granted with the rest, only remarking that the center part of that table should have been thicker.

There is not much to kick about when it comes to the depth of the bed. The only thing I object to is the way he gets it. Looking up ads in the AMERICAN MACHINIST is not bad; but it seems to me that somebody must have had a boring

mill and the depth of its bed before he could advertise it, even in the AMERICAN MACHINIST. There are two kinds of boring-mill beds—two very distinct kinds. One is the kind that is bolted down to a foundation, and the other kind isn't. It is generally the smaller fry that has to get along without a foundation and which, therefore, gets a deeper bed. This must look like an inconsistency to the casual observer, but is really good practice. I would have made the bed of this mill a little deeper, say about 2 inches; preferably more. Though it may not always be possible to put the mill in a hole (for instance, when it goes on a second floor), it is always possible to put a hole around the mill by raising a platform for the operator. Most people are willing to build this platform and bear up with what little inconvenience it causes for the sake of getting a stiffer mill.

THE HOUSINGS.

Entropy gets me entirely muddled when he talks about the width of the posts. He says that this width should be equal to the depth of the bed, but I have to confess that I have not the remotest idea why this should be so. The stresses in the different members of a boring mill are rather complicated, due to the fact that there is combined torsion and bending, and further to the fact that the feed pressure acts in a different direction from the pressure of the cut. Complicated as these stresses are, it is not at all impossible to analyze them, provided there are enough data at hand, such as pressure of cut, length of boring bar, distance between posts, distance from center of mill to face of posts, etc. Even if analysis does not give the actual sizes of the parts, it shows at least proportions. One will find that some sizes of boring-mill parts are determined regardless of the actual requirements. Machine-tool design seems to be a matter of evolution; and as in the ordinary course of evolution many types and dimensions are used which have no right of existence, and which will be weeded out later on by the inexorable law of the survival of the fittest.

Just now there seems to be a race between different manufacturers to pile inches on inches regardless of whether they do good or not. I do not mean to say that the manufacturers do not know better; for I'll confess that, were I in their place, I would do the same. The glib tongue of the salesman and the natural desire of the customer to get the most for his money have led to many things which cannot be defended from a practical or theoretical standpoint, but which have, nevertheless, come to be considered as important points in the design of machine tools. Such is, for instance, the width of the face of the post. It is all right to make the post itself as heavy as circumstances will allow, for that adds to the stiffness of the machine; but the width of the face is of no special importance and simply costs money to produce. The considerations which enter into the determination of this width are worth while talking about, for they do not belong to any one of the groups of reasons Entropy gives, nor can they be found in any book, so far as I know. They might be grouped under the headings "Competition and Policy." It would never do for the Rigidity Tool Company to have less width of housing face than the Power Machine Company offers to its customers; especially not, when the Rigidity Company brings out a new line of boring mills; and when the Power Company a year later redesigns its tools they must go the Rigidity Company one better. And so the merry war goes on, leading to improvements now and then, but more often holding real improvements in check, so as to be able to produce more talking points. There may be no real merit in a thing, but as soon as your competitor makes a great fuss about it and calls attention to it in all his literature and instructs his agents to do the same, you will have to follow suit or be left out in the cold.

Surface on a housing post is of absolutely no value, for the crossrail does not travel along the housing when under strain. In this war of figures the smaller manufacturer, or rather the manufacturer of smaller mills, has, for once, the advantage. Here is where the considerations of policy come in. A machine-tool maker who does not go beyond a 6-foot mill with his sizes, can make the housing face almost anything he pleases. He might make it 18 inches or even more without bankrupting himself or his customers; but the manufacturer who goes up to 30-foot mills must be a little careful as to what he gives in the smaller mills. Suppose such a large builder makes the following sizes: 6, 7, 8, 10, 12, 14, 16, 20, 25, 30-foot (neglecting the extension mills). Supposing further, he starts in with a housing face of 15 inches (such as Entropy recommends), then he would have to go on somewhat as follows:

6-foot mill,	housing face,	15	inches
7-foot mill,	"	17	inches
8-foot mill,	"	19	inches
10-foot mill,	"	22	inches
12-foot mill,	"	24	inches
14-foot mill,	"	26	inches
16-foot mill,	"	28	inches
20-foot mill,	"	32	inches
25-foot mill,	"	36	inches
30-foot mill,	"	40	inches

The increments were really too small to make a good showing, and even then they led up to dimensions which were prohibitive; not perhaps from the designer's standpoint, but from the standpoint of the manufacturer and his friend the customer.

Entropy may have been right in selecting 15 inches for the housing face of his mill if he had no other mills to design; but he would have brought his employers into trouble if they were bringing out a line of mills, as is generally the case. What he should look after is stiffness, and where he can reach this by the use of a little extra iron, as he calls it, there he is right to put it in; but it strikes me that putting it in a housing face is not placing it where it will do the most good.

I am again at a loss to explain why the width of the crossrail should be the same as the depth of the bed. I have in mind a line of heavy boring mills, where the bed is uniformly 22½ inches, but where the crossrail changes its width from 24 up to 42 inches for the different sizes. There is practically no relation between depth of bed and width of crossrail. As I explained before, the smaller mills have often a deeper bed than the larger ones. Even if the two parts had to stand the same strains, they are so dissimilar in shape and construction, that a comparison as to depth of bed and width of rail is out of the question.

JUDGING FROM SKETCHES.

It has been pointed out time and again in this paper and elsewhere, how useless it is to make a sketch of a large machine for the purpose of judging how it will look when done. Especially useless is such a sketch when it shows only one view. You might just as well make a side view of a piece of mission furniture and condemn it on the strength of that view. He is a very green hand at the designing business who depends on such a sketch. The designer who understands his business knows how the thing will look without sketching it on a piece of paper. He knows it by experience. It takes several years' application to this business and a natural aptitude to see it with the mind's eye; but the experienced man sees it plainer than any sketch could show it.

If I am allowed to philosophize for a moment or two, I would call attention to a peculiarity of the human make-up. There are certain trades or vocations which everybody seems to think come natural to a human being. The average citizen won't claim that he can do a job of plastering, nor will he tackle masonry nor blacksmithing; but he feels perfectly confident when it comes to carpentering or plumbing. Why? Give it up. Similarly, the average shop man thinks he is ready to become a famous designer at a moment's notice. He will agree that he is a very poor hand at making drawings, and he will admire the work of a man whose chief virtue is the making of smooth lines and nice letters, but the real art of designing is an open book to him. The planer hand would scorn the idea that the designer could give him pointers on how to handle work on a planer; but he will unblushingly give the designer advice as to how to design a machine. This is all wrong. The planer hand is right to think that he knows something about planing, and that the designer should keep his mouth shut unless he has something real good to suggest. But, on the other hand, the designer also is right when he

thinks that he knows a little more about the designing business than the planer hand. I do not mean to say that either one cannot learn something from the other; but that this is the exception rather than the rule. It is also true that there are some planer hands who were meant by nature to be designers; I presume there are some laborers too who would do well in that line, just as there are some draftsmen who would make good laborers and not much else. What I am driving at is that a great many shop men fail to understand that the art of designing is something which must be learned by hard work.

THE BORING BAR.

There is not a word in Entropy's whole story as to how to get at the size of the boring bars, saddles, swings, etc. He is satisfied with the remark that the heavier they are the stiffer they will be. I cannot kick about that. I do kick, however, that he makes a compromise, so as not to get the distance from the face of the housings to the center of the mill too large. This boring-bar business is, perhaps, the most vexing question in the design of the mill; for with a change in the travel of those bars there should be also a change in their size, in the size of the crossrail, housings, and some other parts. It has happened many a time that I have had to rearrange the entire mill because a customer wanted more boring-bar travel than the standard mill of that size would give. A few inches more will do no harm; but, when the overhang of the bar is increased, say 30 per cent., then it is about time to look into the other dimensions of the machine.

After the size and power of the mill are determined upon, this matter of boring bars should be taken up, and if one finds that the distance from the housing face to the center of the mill becomes rather large by making the bars, saddles, etc., of the proper size, then there is only one thing to be done, and that is, to make the other parts also large enough. Someone may want a travel of bar of 10 feet (I have run across such requirements), and he may have some very good reasons to want it. If Entropy ever runs up against such a customer, he will do well to spend some time looking over the dimensions the parts of his mill will take, before he makes a price on this machine, or else he will be up against it most awfully. No compromise there if you please.

THE CROSSRAIL.

The design of a good boring-mill crossrail is particularly difficult because the strains vary from practically all bending to practically all torsion. This is especially so, when the travel of the boring bars is unusually great. A good way of going at it is, to lay out the stresses in the crossrail for a few different positions of the saddles and for various overhang of bars, and all with the pressure of the heaviest cut. Then do the same thing with another mill, which you know is a success, and take care that the strains in the new structure do not exceed those in the old one. This is perhaps more of a cut and try method than would please a college professor, but it is at least based on something. The bellying crossrail, though no favorite of mine, has some reason for existence. It is about the logical shape where the bending stresses are greatly in excess of the torsional stresses. It will not do to compare it to a bellying lathe bed, because the stresses in an ordinary lathe are always torsional, due to the action of the cut being at an angle with the horizontal.

I hate to go up against Professor Sweet. I consider it one of the first requirements for self preservation to give the right of way to the better man, and I recognize Professor Sweet as such. I do not know, however, where or when he said that one elevating screw is better than, or just as good as two screws for a boring mill, nor do I know if he said it at all. If he did say so, he may have meant something else than what Entropy makes out of it. The center of gravity of a boring-mill crossrail and parts is a rather elusive thing. It depends very much on where the heads are. Of course it would be all right if the maker of the mill could make the buyer swear that he would always put the heads in a certain position before elevating the rail. But how is he to keep the man up to his promise? Then there is another thing. Many boring mills get special attachments, such as central boring heads, grinding attachments, slotting attachments, etc., and it is well to so design the machine that these attachments can be attached without changing the entire mill.

For these and similar reasons, I hold that it is good policy to have two elevating screws, though I do not doubt for a minute that one screw will do the work just as well under certain conditions. As to the assertion that a boring-mill crossrail should always stay square when it once was square, this sounds a good deal better than it is. This thing is too much like the story of the famous Chicago lawyer, and his client who was in jail. You know the lawyer argued that they could not put the man in jail, but he was there just the same. Crossrails do get out of square, especially on large boring mills. Let me illustrate with a large mill—unusually large, it is true, but not at all the largest existing. The distance between the housings was 20 feet, the hight under the tool holders being 15 feet. The exact distance between the housings was an ever changing quantity, varying by a few thousands of an inch. To keep a good fit, such a boring-mill rail is provided with a gib. This gib has to be loosened every time the position of the rail is changed. Smaller mills show the same thing, only to a less extent. Then there is a certain amount of settling of the foundation to contend with. This may not be enough to seriously interfere with the work, but quite enough to throw the rail out of square, and make it bind on the housings.

What the crossbrace at *m* is supposed to do is more than I can understand. It may be that I do not understand the drawing; but the way it looks to me this brace is nothing but a rib cast to the top of the bed, and perhaps fitted between the housings. It does not seem to be bolted to the housings. Really, I do not know what it is supposed to do.

THE BEARINGS.

In the design of an annular bearing for the table and the spindle bearing Entropy guesses again, as he has been guessing at all of the rest. Why didn't he decide on the maximum load which is to come on the table, the weight of the table itself, and the pressure of the cut, and further, the number of pounds pressure he would allow per square inch? And how in the world does he reason that the only pressure against the spindle bearing is that due to the feed? Isn't the pressure of the cut there too? The two pressures are not in the same direction, so that the total pressure is not the sum of the two, but both are there just the same. Here again he should have determined the pressures, and then allow so much per square inch. His idea of making the spindle bearing adjustable, and at the same time fixing it so that you cannot adjust it, would deserve a patent if it were new; but it isn't. In a shop where I spent some years of my life, and where they make agricultural implements, the practice was to make everything adjustable, say by means of a screw and nut, and then rivet the screw over so that the farmer could not monkey with the adjustment. I never knew, though, that this same principle was also applied to machine tools.

THE DRIVE.

There are a few points about the drive, too, which might be different, if nothing else. A speed of 20 feet on 72 inches is all right for the lowest speed, but 40 feet on 3 inches diameter is unnecessarily fast. In the first place, I don't like the idea of running the table with a circumferential speed of about 900 feet. What is more, by spreading the range of the mill beyond its actual requirements the gap between two adjoining speeds becomes too wide, and much time will be lost every day because the proper speed for the operation is not at hand. He might have made the highest speed equal to a speed of 40 feet at about 4½ inches diameter. This would have reduced the range of the mill to about two-thirds of what he proposes, and would have made the gaps that much smaller. The time lost because the speed is too low on very small work is not enough to talk about, for a 72-inch boring mill is generally used for work under 3 inches in diameter.

That a constant belt-speed drive is the only allowable thing nowadays is true with some people, but not with others; and especially not with those who judge a thing by its merits. However, a constant belt-speed drive is not a bad thing when it is good. But it must be a sight better than Entropy's, or it would be liable to run away with the booby prize. Just imagine his spiral-gear drive with a ratio of 8 to 1! This is too horrible to contemplate. Not that it cannot be done, for worse things are being done every day; but think of the trouble he is going to run into. Well, Entropy deserves it for the rest of his design. And then that spiral pinion has to be made so that it will slide out of mesh when the miter gears are used. I am glad he did not tell how this is to be done, for I would hate to become a chronic kicker. But the best part of all is the way he does *not* solve the problem of how to engage a pinion with three sets of gears on two parallel shafts; gracefully he leaves it to the imagination of the reader. I advise the reader who has the necessary imagination to get out a patent before he publishes this thing in this or any other paper, for it is worth a fortune, if it is worth a cent (which is doubtful).

THE USE OF BOOKS.

Books on designing are very much like cook books. Some fair young lady, fresh from college, and who can play tennis and the moonlight sonata to perfection, may make a mess out of the best recipes of the best cook book, but the book is not to blame for it. The trouble is with the fair one. But give a good cook book to a good cook, and she can do a whole lot of things which she could not have done without the book. So it is with designing. Give a good rule to a good man, and he'll apply it the right way; but don't think for a moment that a table of rules and formulas make a designer. Plenty can be found in a good book on machine design, which will show the careful man how large the shafts should be made. There is practically no relation between the size of the spindle and the size of the vertical shaft; and for my part I consider 4 inches entirely too light for a mill which has to do such heavy work. The horizontal shafts, too, are entirely too light.

Further.....

How I have been kicking myself since writing the last word. All this trouble for nothing. Entropy is all right. It was I who did not see where the trouble was. It was not with Entropy at all. It was with the typesetter. And such a small mistake, and right at the beginning of his article, too. Just make the title "How Not to Design a Boring Mill" and everything is all right.

Automobile Construction—IX.

BY F. C. MASON.

In the original plan of the machine I showed the frame with o.g. side members. A great many cars have been built this way, but the tendency of the times is to do away with the feature. I also showed the engine placed directly on this frame. In the accompanying drawing, Fig. 27, I show a frame with straight side members and a sub-frame to hold the engine and transmission.

The frame proper may be made either of pressed steel, as in the drawing, or of angles. If you use the latter, make of 2x2x3/16 inch thick. The sub-frame is made of channels and angles of the dimensions given, with all joints securely riveted.

The springs of course must be bolted on, and if a pressed-steel frame is used it should be reinforced where the spring is attached. The average pressed-steel frame of these dimensions is made of about 12-gage stock and would not be heavy enough to allow the spring to be fastened direct. The spring should be 4 leaf 1¾ inches wide.

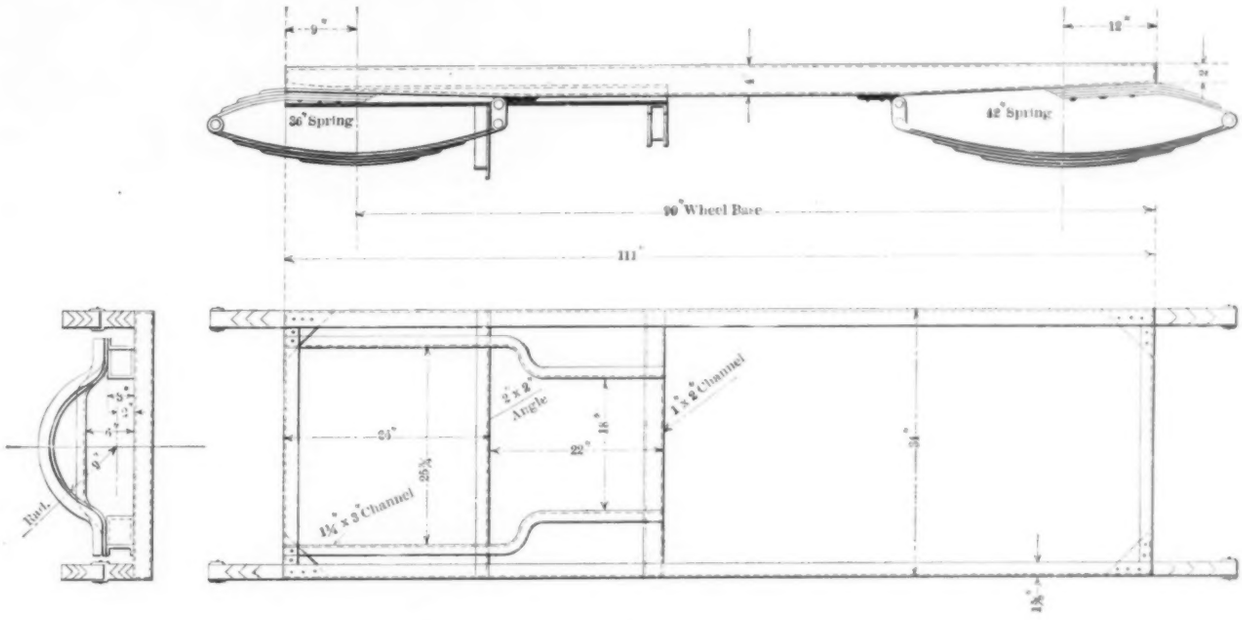


FIG. 27. A FRAME WITH SUB-FRAME FOR ENGINE.

Thrust Bearing and Commutator for Gasolene Launch Engine—A Correction.

The article bearing the above title, which apeared at page 420 over the name "E. Q. Williams," should have been credited to F. R. Williams.

Seventy-two per cent. of the area burned over by the Baltimore fire of February, 1904, has been rebuilt. The area covered by the burned buildings was 2,300,000 square feet, a portion of which was taken for street widening. The new buildings have an estimated value of about $20,000,000.

A method of removing a rusted screw is to apply a red-hot iron to the top so as to heat it and immediately use screw-driver.

ERRATA.

On the engine drawing at page 874, Vol. 28, Part 2, I gave the crank-case dimension from cylinder to cylinder as 8⅝ inches; this should have been 9¾ inches. I formerly used a piston with two rings, one at each side of the connecting-rod pin. In the present construction I added a third ring, making the piston ½ inch longer, and added 9/16 inch of stock to each boss where the cylinder is fastened to the crank case, but neglected to change the figures. The plan of the chassis, page 847, shows a 58-inch tread; this should be 54 inches instead.

Works and Methods of Alfred Herbert, Ltd., Coventry, England—I.

BY I. W. CHUBB.

Among English tool-builders the firm of Alfred Herbert, Ltd., Coventry, easily takes a position in the front rank. A cosmopolitan concern, with show-rooms and offices in half a dozen towns in the United Kingdom and also in France, Italy and Japan, the business has grown from a small general engineering and repairing shop to perhaps the most modern machine-tool establishment on the European side of the Atlantic. And one need not be very old to remember the repairing period. Beginning at page 1155, Vol. 24, a full account of the works as then arranged, now nearly five years ago, appeared in this journal. Then about 690 men were employed. Now, all told, 1400 workpeople are engaged, largely on piece-work. Of course there are a number of engineering firms in Great Britain employing more men; but no one of them is concerned solely in machine-tool production, at which for numbers of workpeople the Coventry concern is easily first. The enterprise of the firm is undoubted. Not many British firms see the advantage of sending members of their staff abroad, simply to study the methods of competitors and engineering friends in the States and on the European continent. Yet this is a regular feature of the Herbert firm.

The industrial history of Coventry is a record of continual change to meet altered circumstances. To the student of economics it offers many attractions. Even as regards the branch of history which concerns itself with kings and battles, the Coventry district is not without interest, while the literary person will connect it with George Eliot. Indeed, one of the chiefs of the Herbert staff lives in the house which is reputed as a school of Mary Ann Evans. True to its character, Coventry has just returned a novelist to the British Parliament.

The Herbert firm has two establishments—the one to be here described and a foundry at Edgewick, two or three miles away. Into the latter a number of mechanical engineering notions have been introduced and it may form the subject later for another article. Concerning myself for the present with the machine-tool works only, I must at once thank the firm, and in particular P. V. Vernon, well known to readers of this journal, for facilities and opportunities freely given.

FIG. 1 VIEW IN MAIN DRAWING OFFICE.

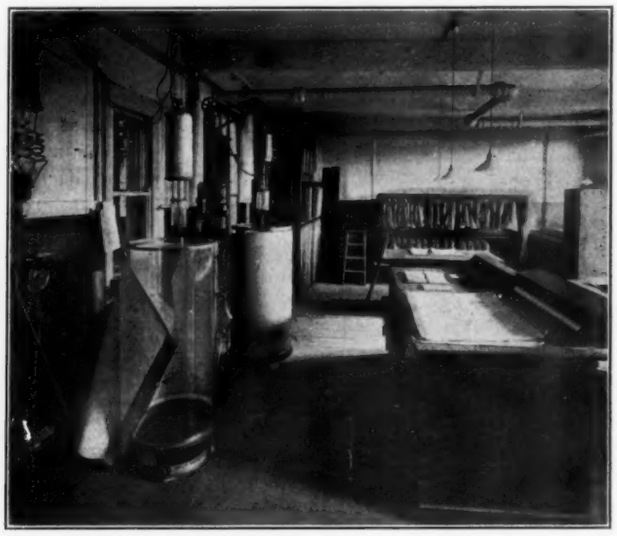


FIG. 3. THE BLUE-PRINT ROOM.

FIG. 2. VIEW IN TRACING OFFICE.

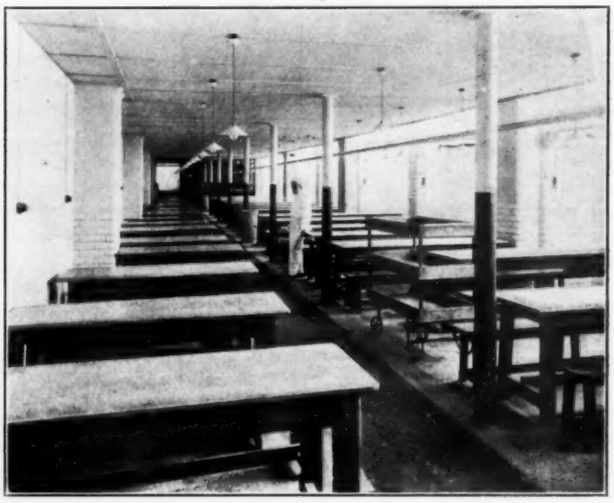


FIG. 4. THE MESS ROOM.

PRESENT GENERAL ARRANGEMENT OF THE WORKS.

The head works in Coventry show considerable extension when compared with the shops illustrated in the former series of articles. Practically the whole of the works have been made into one large shop under one roof. The only buildings having more than a single story are the offices and the small-tool department in

front. The stores, which also serve as control department, occupy about the central portion of the floor. This decreases the average distance over which jobs have to be carried for inspection, the inspection of all the smaller parts being done in the stores. At the rear both the die-head department for manufacturing the Coventry self-opening die-head, with special machine for testing the dies, and the experimental department are entirely new. The latter has been installed for building original machines and perfecting them before commencing manufacture.

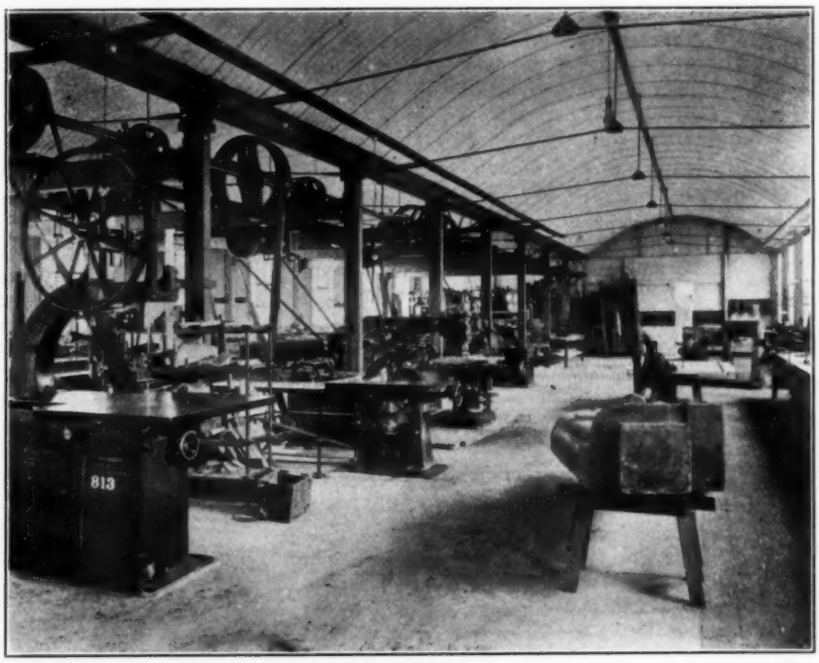


FIG. 5. THE PATTERN SHOP.

A new office building has been erected. The offices now extend from the front of the factory in Queen's Road up to the end of the drawing office, along the side street in a continuous line, with a long corridor from end to end. The various offices, such as correspondence, order, wages, piece-work, estimating, drawing, speed and feed, process organizing, tracing, etc., open out of this corridor and are distinguished by signs projecting above the doors. Telephones are fitted in each department for every part of the works and offices, about 50 instruments being installed.

Recently an entirely new patternshop, a case-making shop and a store for cases have been built across the side street, so as to remove from the main works all danger from fire.

FIG. 6. THE TURRET LATHE DEPARTMENT.

THE DRAWING OFFICE AND ALLIED DEPARTMENTS.

The main drawing office is partly shown in Fig. 1 and it may be noted that in the larger number of cases the Universal drafting machine is in use. Owing, however, to difficulties of arrangement, it is impossible to show the whole of this office in one view. The total staff of this department numbers about 55 and it is worth noting that in the design of the machines standard parts are used wherever possible, the number of distinct and different sheets used here and showing standard details reaching 150 at a low estimate. One end of the department is concerned only with designing special tools for jobs, the time of which is guaranteed. In the tracing office, Fig. 2, all the tracings, with a very few exceptions, are made by young ladies, who have been specially trained. They do extremely good work and the experiment has been quite successful. In fact it is not probable that any engineering works could show better tracings. The girls work in a separate office, so as to be free from interruption, and are in charge of a lady chief.

In the blue-print room, Fig. 3, can be seen on the left two electric machines for blue-printing, which are kept going all the time. At the extreme right, in the corner, is the tank for washing the blue-prints. Just in front of this tank is a gas-heated oven for drying blue-prints which are wanted quickly, and on the back wall is a rack for drying those which are not urgently required. The table in front is used for cutting the paper to size. The paper is kept in a box with a cover. This has a sharp edge, on which the paper can be torn off when the right amount has been drawn out. In the illustration one of the covers is shown open to explain the construction. Connected with this department is the photographic room, in charge of a skilled man, who photographs all machines and is responsible for taking all the photographs here reproduced. He is in charge, also, of all blue-printing and mounts the drawings, but does not issue them to the workmen. This department also contains the fire-proof strong room, where drawings and tracings are stored. Drawings are given out to the draftsmen and put away by boys kept for that purpose only, applications for drawings being made on printed slips. The boy in charge of the strong room also keeps records similar to the tool-room records, so as to be able to locate any drawing quickly. The mounted blue-prints for the works are usually sent out in triplicate, one copy of

each going to the machine shop, erecting department and stores. Here they are properly filed and numbered and given out to the workmen on checks, thus relieving the drawing office of the detail work of issuing drawings one at a time.

THE MESS ROOM.

The mess room, Fig. 4, has recently been constructed below the level of the street and under a portion of the erecting shop. It is lined with white glazed bricks and will comfortably seat 400 men at meal time. It is in charge of an attendant provided by the firm. The men bring their own meals, which are cooked or heated free of charge. Cycle accommodation for the works is provided in the yard and also at the pattern shop and near the paint shop. Throughout the works Bundy time clocks are placed in each department.

THE PATTERN SHOP.

Fig. 5 shows the pattern shop, which is in a separate building and has a satisfactory assortment of modern pattern-making tools. This shop is of steel frame, covered with corrugated iron, the roof being lined with wood, tongued and grooved and sprung to place. The building is cheap, the lease on it being short. Driving is by electric motor and heating by exhaust steam, the cable and steam-piping being brought from the engine-house across the street under the public road, the municipal corporation being paid a nominal rent. By the way, at the entrance two sets of doors are provided: one to open one way to comply with the British Factory Act requirements, the other to open in the opposite direction so as to meet the wishes of the local authorities.

The small-tool department has lately been considerably increased in capacity. Unfortunately the arrangement of the machinery does not permit a good photograph to be taken. Gear-cutting has been entirely removed from this department, which is devoted solely to the manufacture of small tools. It will be impossible to describe the whole of the works quite fully, but a number of disjointed notes may be set down at once. Thus the drilling department is placed near the fitting sections for convenience in marking out. Then in the thread-milling department the Acme form is used for all feed screws, leading screws, worms, etc. Again a special department is organized for machining brass, which is therefore kept separate from other metals.

TURRET LATHE DEPARTMENTS.

Turning to individual sections of the works, the turret lathe department, Fig. 6, contains nearly 100 machines, the greater number having been added during the last four years. The illustration shows a number of these lathes employed on chuck work. They machine practically everything manufactured up to 22 inches diameter, whether made of iron, steel or bronze. Among the jobs shown lying around the shop are conical holders for the chucks of the hexagon turret lathes; face plates for chucks; draw-back collets for automatics, the blanks for which are made on the automatic screw machines, the remainder of the work being done on the hand-turret lathes; portions of the Coventry self-opening die-head; gear blanks; and cone pulleys. These last are

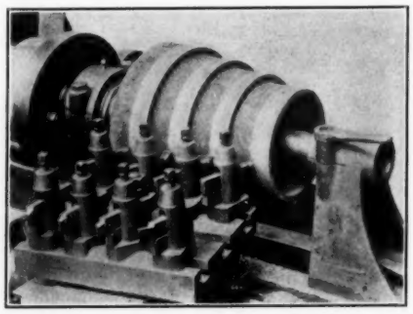


FIG. 7. PULLEY-TURNING LATHE.

only partly machined on turret lathes, the work consisting of boring, turning the small step and tooling the inside of the pulley. The outsides are turned on five special pulley lathes, as in Fig. 7. In fact, the variety of work dealt with by these machines is too great to be fully specified. It will be noticed that most of the turret lathes shown in Fig. 6 have chasing saddles, which are also provided with square turrets carrying forming tools, turning tools, chasers, etc.

The automatic department, Fig. 8, has been considerably extended and comprises 16 machines admitting bars of maximum sizes from ¼-inch up to 3½ inches.

THE GENERAL STORES.

The general stores, which, as has already been stated, also act as a control department, are shown in Fig. 9, which illustrates what may be described as the receiving end, the inspectors' benches with proper testing appliances being seen at the back. Ten to twelve inspectors are employed, the work being collected in batches, checked over for numbers, compared with the drawing, etc., and then taken away for the foreman of fitters. The various parts of the machines are delivered here for inspection after each operation, a tramway running into the stores to expedite the delivery and despatch of work. This is important, as under this inspecting system many pieces have to enter and leave the stores a number of times before completion. In designing machines an endeavor is made to arrange so that all machining can be done before the parts go to the fitters. This of course tends to prevent the jobs passing up and down from one department to another.

As soon as all the machining on a batch of parts is completed, the work is stored in the racks seen on the right-hand side of Fig. 9. These racks extend nearly to the roof and are made in two floors with a gallery, so as to enable the storekeepers to move about without the use of clumsy ladders. When all the machining work required for a batch of machines is finished, almost all the parts will be stored in the racks in the stores. The largest parts, however, never enter the stores. The work will then be laid out on the despatching floor and the man responsible for the erection of the machines can check all the parts from the lists with the storekeeper. As soon as he is satisfied that everything

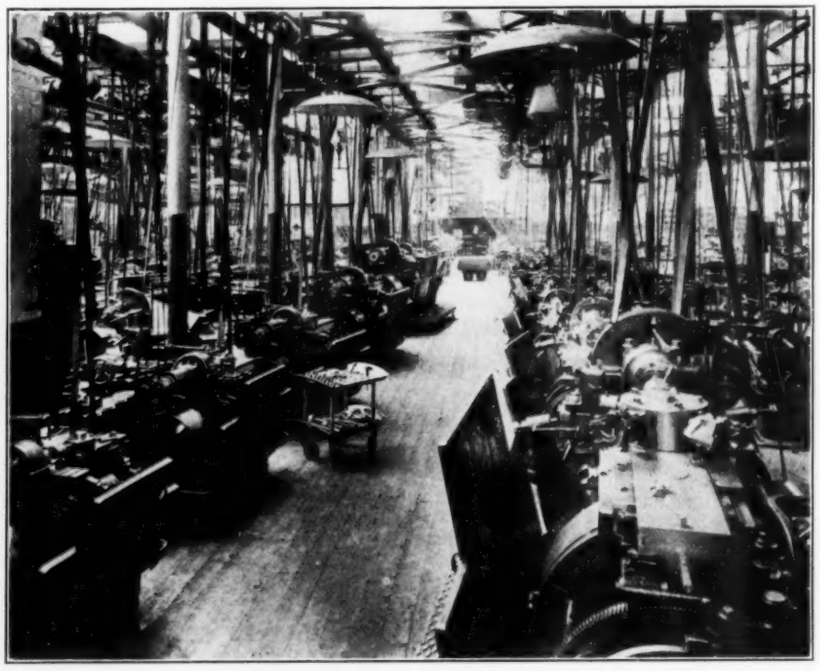


FIG. 8. THE AUTOMATIC DEPARTMENT.

he requires is ready, he signs a receipt, and the work is placed in the trucks and delivered to him. This avoids delay owing to the absence of small parts, the want of which is discovered while the erection of the machine is proceeding. The larger parts are, of course, checked off separately outside the stores.

The office for the control clerks can be seen raised above the floor. At the right-hand side of the stores are the racks for various bolts, nuts and other small standard fittings which are made on automatics, or purchased outside, and which can be kept in stock constantly. In order to facilitate the entrance and delivery of work, certain times in the day are set aside for certain departments to deliver their products. This is found to be a great help to the storekeepers, avoiding sudden rushes and distributing the work over the whole day.

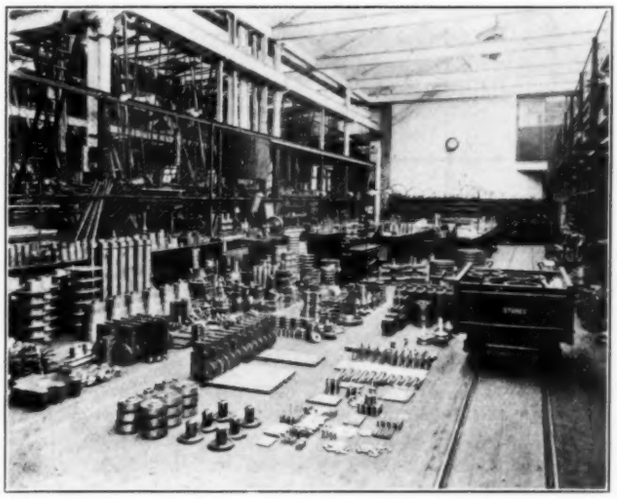


FIG. 9. THE GENERAL STORES.

FIG. 10. VIEW IN ERECTING SHOP.

THE ERECTING DEPARTMENTS.

It is often said that compared with Great Britain, America has a great advantage in the fact that there machines are built in larger quantities than in the old country. Some of the views to be presented will show that at least in one English shop every advantage is taken of the possibilities of economical production by manufacturing in quantities. This is the method throughout the works, all jobs being put through in batches. Thus in that part of the erecting shop used for capstan lathes a group of 24 lathes are under erection simultaneously. As soon as these are finished a similar lot follows, this particular corner of the works being continuously employed on the same work. The headstocks for these lathes are supplied complete from another department, as are also the capstan slides. The main duty of the workmen in this department is to surface the bed, fit the saddle, attach and aline the various brackets and shafts, headstocks and capstan slides, and complete the erection of the lathe. Similarly small capstan lathes, milling machines and other tools are carried through the process of erection in large numbers.

Fig. 10 shows a bay in the erecting shop devoted to hexagon turret lathes, a number of which can be seen in the foreground nearing completion. Generally they are fitted with single pulley headstocks on the constant-speed-drive system, having 16 speeds in either direction, all obtained in the headstock, and without requiring the use of a countershaft. The firm finds this system is quite displacing the older types of headstock. On the left-hand side of this bay are machines for boring the turrets, and facing the flat hexagon faces in position from the headstocks of the lathes themselves.

FIG. 11. VIEW IN ERECTING SHOP.

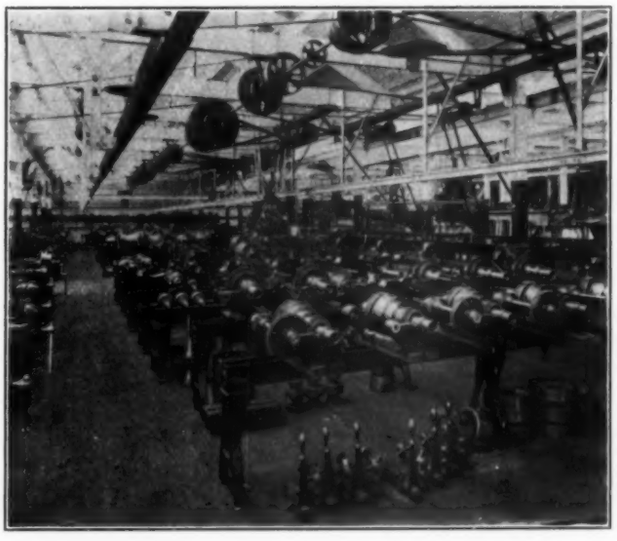


FIG. 12. HEADSTOCK ERECTING DEPARTMENT.

The illustration of the erecting department for automatics, Fig. 11, shows that automatic screw machines are built in considerable quantities.

The headstock erecting department, Fig. 12, is kept constantly employed fitting up headstocks and nothing else. For mounting these during erection special cross benches of iron are provided, so as to

utilize the space to the best advantage. In the foreground can be seen a number of ordinary cone pulley heads. Beyond are some for automatic screw machines, and further back is a batch of single-pulley headstocks, and so on. A light roller-bearing traveling crane is used in this department. After completion all heads are driven for a considerable time at high speed, for the purpose of testing the gears, friction clutches, bearings and lubrication. Speed variators with tachometers are provided for this purpose, so that the precise speed at which a head is run is always accurately known.

A VERTICAL MILLER.

A section of the main shop is given up to the erection of vertical milling machines, one of which in its latest form is illustrated in Fig. 13. The machine has several novel features. One is the dial feed at the side of the column. From this, by the simple rotation of the hand-wheel at the top of the feed box, the whole range of 16 feeds (from 11/16 inch to 12¼ inches a minute) can be obtained while the machine is running. This hand-wheel has a dial with 16 divisions corresponding to the various feeds, which obviates the use of levers and entirely avoids the necessity for feed-tables. The feeds are all tabulated in inches per minute and are quite independent of the speeds of the spindle. The 16 spindle speeds range from 8.5 to 450 revolutions a minute. The steady bracket, for the lower end of the arbor, will swing out of the way. A profiling roller can be attached if desired and screw adjustment added for putting on the cut. For the main table both longitudinal and cross movements have self-oiling slides, a feature which is claimed as unique for such machines. Smooth working of the slide is obtained from a central raised tongue, the slide being held down by gib plates on the outer edges. The guiding portion is therefore very long compared with its width.

TESTING EQUIPMENT.

Most of the machines made by the firm are equipped with special sets of tools for turning out the customers' work in times which are guaranteed. This must be accomplished before the machines leave the works. It has therefore been found necessary to extend considerably and, in fact, reorganize entirely the testing department, Fig. 14. One of the difficulties in a department such as this is to get the machine into position for testing without interfering with other machines. The use of traveling cranes is practically prohibited on account of the numerous driving belts required to run the machines under test. The way in which this difficulty has been overcome is clearly shown. A line of rails is arranged on each side of the department, the tracks being so fixed that it is possible to have a row of machines on each side of each track, thus providing for testing four lines of machines at once. The track is kept clear and a machine can thus be brought by trolley into any part of the department in a longitudinal direction without interfering with any other machine. It still remains, however, to get it into the right position transversely, that is, in a direction at right angles to the length of the shop. To do this a number of cross girders have been provided, each of which has a set of 5-ton traveling chain blocks. The girders are placed close enough together to cover the whole of the department without any further longitudinal movement of the machine after it leaves the trolley.

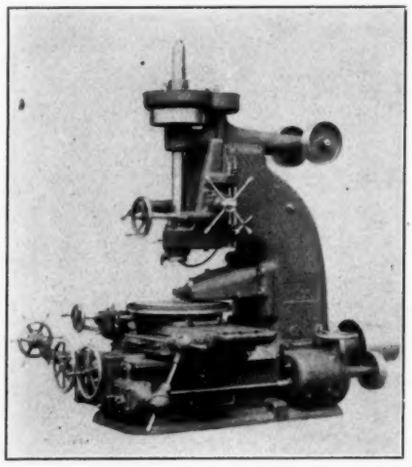


FIG 13. VERTICAL MILLER.

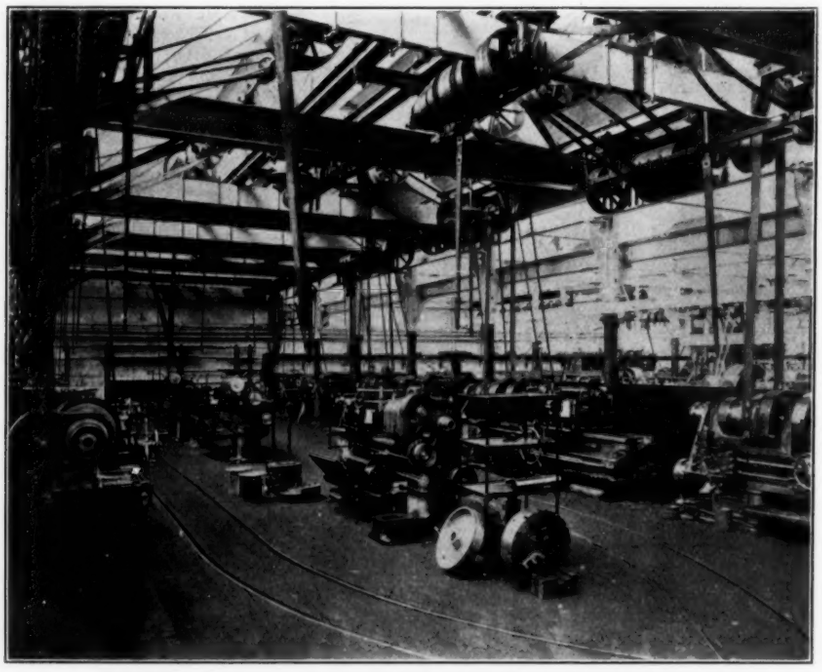


FIG. 14. THE TESTING DEPARTMENT.

As it is impossible to foretell what kind of machines will at any future period occupy the testing department, obviously the countershafting for this department must be very elastic as regards speed variation. The maximum space has therefore been allotted for testing, and the countershafts have been grouped according to the various classes of machines to be driven. The overhead cone pulleys are overhung so as to be easily changed to suit different machines, and many of the countershafts have wide ranges of speed variation by means of supplementary counters, with cone pulleys driven from others on the line shaft. The department is driven by electric motors, several being of variable-speed type. The testing department staff consists of men of special experience in the actual running and testing of machines, and in many cases these men proceed to the customers' works to instruct workmen in the operation of the machines on the spot, even after the test has been satisfactorily accomplished.

Museums of Security.

On the evening of March 28, Dr. William H. Tolman, director of the American Institute of Social Service, exhibited before a small party at the residence of the Rev. Percy S. Grant, 7 West Tenth street, New York City, a series of over 100 stereopticon slides illustrating the subjects of "Museums of Security" and "Prosperity-sharing." Dr. Tolman's views and descriptions were preceded by an address by Dr. Josiah Strong, president of the Institute, upon the subject of accidents to life and limb, and the great importance of a strenuous campaign for the universal use of precautions in order to reduce the enormous annual list of casualties, in the four great industrial divisions, viz.: railroading, mining, manufacturing and building. During the year ending June 30, 1904, there were 10,046 killed, and 84,155 injured on the railroads in the United

States, and the annual rate is steadily increasing so that the prospects are that during the next five years about 60,000 persons will be killed on the railroads, among which number "any one of us here present may be," as Dr. Clark significantly remarked. And, moreover, by comparison with the experience in European countries, it appears that the greater number of these accidents are needless and preventable. John Mitchell stated in his recent book that in the anthracite mines two miners are killed and five injured for every working day in the year. In factories in the State of New York, in trades not particularly dangerous, 44 accidents per thousand employees per annum were reported.

It was for the purpose of collecting and making accessible with ease all obtainable knowledge on the subject of safety measures, and making the plea of ignorance impossible, that handsome buildings have been erected in Amsterdam and Berlin, and filled with samples of such appliances. We hope at an early date to present to the readers of the AMERICAN MACHINIST some illustrations from among the Institute's large collection of photographs taken in these museums.

Among the slides exhibited were many very pretty views of Port Sunlight and Garden City, England, where the manufacturers have disposed of a considerable portion of their earnings to the advantage of their employees, by the building up of beautiful villages, whereby these people have attractive homes, with pure air and water, gardens, lawns, trees and flowers, besides good streets, schools and other municipal advantages, placed within their reach at surprisingly low cost.

Professor Diederichs, of Cornell University, who last year made a test of the Baltimore & Ohio Railroad power house in Baltimore, recently went with nine seniors in the mechanical engineering course on the round trip between New York and Cuba on the Ward Line steamship "Morro Castle," in order to conduct a thesis test on the ship's boilers and engines. A newspaper account states: "When the oilers and stokers saw the kid gloves and long overcoats coming abroad, and found out what was to be done, they prepared for fun. They got a surprise. . . . Mutual respect having been established, the amateur overall bunch and the professionals became fast friends." The students worked steadily and faithfully at their incessant observation-taking, but they had a pretty good time, all the same, entertained the crew with songs, and when back in New York gave the Cornell yell on the pier as a parting shot.

Consul Harris, of Chemnitz, reports that tests are being made of five systems of filtration apparatus to purify the waste waters of the 250 factories there, and the most satisfactory one will be adopted.

Fire-Brick Work.

BY R. P. KING.

To most men, both employers and employed, and, unfortunately, many professional engineers, a fire brick is merely a fire brick. Furnaces and similar structures lined with fire brick are often built by bricklayers accustomed to working on buildings, who know next to nothing of the peculiar methods employed when building fire-resisting structures. Large cities and those localities in the vicinity of glass and steel works, are fortunate in the fact that workmen may be found whose specialty is the building of fire-brick structures. It is a noticeable fact that these localities demand a better and more expensive grade of fire brick than others.

I will, in this article, touch upon some of the important points of this class of work, particularly in reference to boiler setting. Most of the facts given are well known to those engaged in the erection of high-class water-tube boilers and stoker furnaces, but are too often neglected by others.

For the proper understanding of this subject it is essential that the reader have at least a superficial knowledge of the chemical composition and the manufacture of fire brick.

There are several grades of fire brick, nearly every manufacturer supplying at least two, the first and second qualities being different in more respects than price. Firsts and seconds may be said to bear the same relation to each other that is borne by the portland and natural hydraulic cements, the former in each case being an artificial and the latter a natural product.

COMPOSITION OF FIRE BRICK.

The clay from which fire brick is made contains from 63 to 80 per cent. of silica, and from 18 to 30 per cent. of alumina. Oxide of iron may be present in small quantities, usually less than 2 per cent., and its presence is easily detected by the red color of the brick. Carbonates of lime and magnesia are usually present in small quantities, and their presence is detected by testing with muriatic acid which causes an effervescence on the brick. The presence of lime and magnesia in any quantity seriously affects the fire-resisting quality of the bricks, rendering them fusible. Salts of potash and soda may also be present in the clay.

The finest form of fire clay called kaolin, is composed of silica, alumina and water, the last not being in combination. The impurities mentioned above act as a flux when the bricks are heated, causing them to soften or even melt, and upon their presence or absence depends in a great measure the quality of the bricks. For instance, an increase from 2.5 per cent. to 5 per cent. of these impurities reduces the fusing point of the bricks by not less than 300 degrees F.

Fire clay is sometimes found in banks and is always found in coal mines under the coal. It is first ground in dry pans, and for the second-quality brick is hand molded, re-pressed and burned in kilns. First-quality bricks are made of ground clay mixed with quartz sand, while bricks of exceptional fire-resisting qualities are sometimes made of the ground fire clay mixed with quartz sand, and a quantity of roasted quartz sand. A certain high-grade brick is said to be composed of "33 per cent. of calcined flint, 57 per cent. of raw flint, and 10 per cent. of plastic clay." The analysis of this brick is said to be:

Silica	68.50
Alumina	29.00
Ferric oxide	1.00
Lime	.80
Magnesia	.25
Alkalies	.70
	100.25

The brick tested by heat gave the following results:

Brick glazed at	3150 F.
Fused at	3300 F.

The fire-resisting quality of a brick is not, however, in every case, the index of its usefulness for boiler setting. Some bricks, under the action of heat, become soft long before the point of fusion is reached. Such a brick is manifestly unsuited for boiler work, as flat arches built of such a material would settle to an alarming degree, and furnace walls that become soft could be pulled out *en masse* when cleaning the fire of the clinkers that are so objectionable in some bituminous coal districts.

Silica bricks are used where extremely high temperatures prevail, as in glass and steel furnaces, but these bricks are very brittle when heated, and a sudden draft of cold air will splinter the corners off. The co-efficient of expansion of these bricks is high, making arch and furnace construction an exceedingly difficult problem.

Fire bricks differ from silica brick in that they contract when heated. This fact should be borne in mind when designing arches and furnace walls, and when locating stays or other steel work that expands when heated.

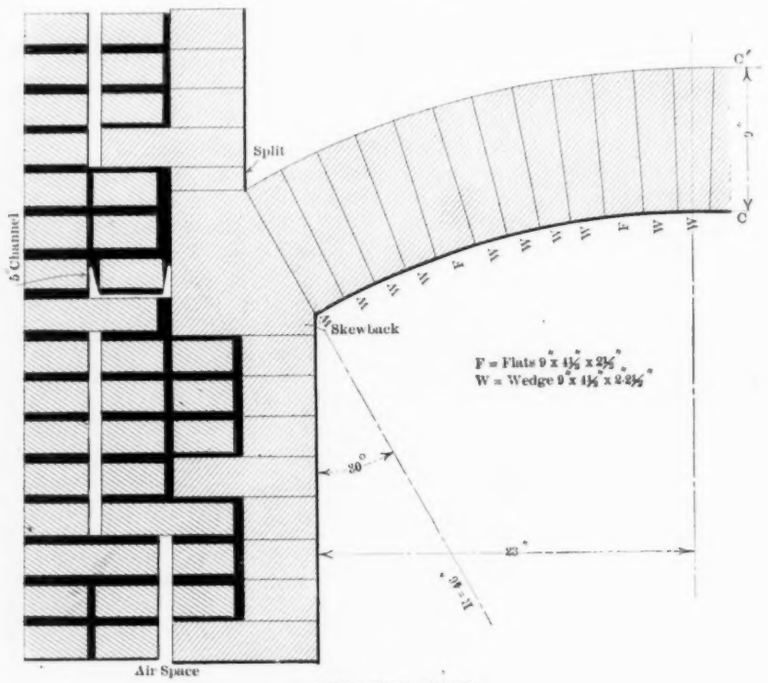
SELECTION OF FIRE BRICK.

Boiler settings differ in different sections of the country, in some localities the custom being to line the setting throughout with fire brick, while in others the fire box is lined only as far back as the bridge wall. The former is by far the better practice, and the lining of the fire box proper should be a first-quality brick, as hard as can be conveniently obtained. The combustion chamber may be of second-quality brick. Arches and skewbacks for stoker and smokeless furnaces

should be of the best brick obtainable, which must possess the quality of fire resisting in the highest degree. These bricks need not be selected on account of hardness, although they must not soften under 3000 degrees F. Brick for arches must be selected with a view to absolute uniformity of size, contraction and fusing.

First-quality brick cannot be bought for less than $35 per thousand, which seems like a heavy price to pay, but they are well worth the difference. Second-quality brick can be bought for $30 or less. In general it may be said that for seconds used in boiler work, the cheapest are the ones to buy, provided they are reasonably uniform in size, hard and not friable under sudden changes of temperature.

I consider uniformity the most important quality in a fire brick. I would prefer a good second, uniform in size, hardness, contraction and fusibility to a first-quality brick that lacked these qualities. The reason for this preference will be apparent later.



A FIRE-BRICK ARCH.

When selecting brick for a boiler setting, the red brick for the backing should be selected with as much care as is given to the fire brick. These bricks should be hard burned, swells and bumps not being objectionable unless, of course, the distortion is so great as to prevent good laying, the point I wish to emphasize being that the appearance is of minor importance. The size of the red brick should, however, conform to the size of the fire brick, so that header courses may be put in regularly and as often as necessary. By this I do not mean that the brick must lay up the same hight, course for course, although this is desirable, but the courses should be so arranged that all headers be laid absolutely level.

LAYING UP FIRE-BRICK WORK.

When designing a boiler setting, the same care and thought should be given to detail that is given to the design of an engine.

The illustration shows how care can be used in working out a problem of this character. It is something of a task to persuade the bricklayer that this is the correct method to pursue, but he is not responsible and the designer is.

Many writers say that for good work the clay should be the same as the bricks are made of. I do not believe that this is essential, my experience being that nearly any clay is good, provided it is finely ground. As already explained, good fire brick is about 90 per cent. quartz sand, a material impossible to duplicate in the clay wash. There are many patent compounds intended for substitutes for clay, many of them designed to fuse, and thus cement the brick, the flux appearing on the surface of the brick in the form of a glaze. If this effect is desired, a little common salt mixed with the clay will have the desired result.

Fire clay has practically no cementing power, and its comprehensive strength is comparatively low. Its principal office is that of a filler, and as its fire-resisting qualities are not as good as a high-grade brick, the less clay used the better. It is on this account that I value bricks that are uniform in size, as such bricks can be laid with comparatively little clay. In fact, the joints, especially for arch work, need be no thicker than a sheet of blotting paper.

When calculating arches and other first-quality work, I figure on laying the work up dry, fitting the joints closely; after which it is possible to take out the brick and lay them back, with clay, getting the same number of bricks in the space allotted. In order to do this it is necessary to use the clay very wet indeed, in the form of a wash, into which the bricks are dipped.

I have noticed that under intense heat, in arches and walls that are laid with open joints, the fire clay has a tendency to disintegrate and run out like sand, thus exposing the edges and corners of the brick to the fire. It is a well known fact that the sharp edges and corners of a brick will fuse and round over long before the body of the brick has been affected by the heat, and that arches and walls that have been attacked in spots so that holes have developed, will be wasted away much more rapidly than work that presents a practically plane blank wall to the action of the flames. For this reason alone, uniformity of material is of vast importance where building a fire-brick structure, as even a job of high-grade material, which is not uniform in a fire-resisting quality, will develop those spots and disintegrate very rapidly.

In the illustration I have shown a half arch and one arrangement of the skew back and side wall that support it. The construction of the side wall has already been touched upon, and presents no unusual features. It will be noticed that I have shown a header course every fourth course (three courses between) which is not too close for first-class work. The skew backs for flat arches require more attention than is usually given them, as upon their stability depends the strength of the arch. For this work it is far better to use specially molded skew backs, of a form similar to those shown in the illustration. Back of the skew backs, well protected by the masonry, should be placed structural steel of suitable form to carry the thrust of the arch to the buck staves. I have used old railroad iron for this purpose with success.

CALCULATIONS FOR AN ARCH.

Taking for an example the case illustrated where the angle of the proposed skew back is 30 degrees from the vertical, and the width of fire box 46 inches, one-half the span or 23 inches divided by the sine of 30 degrees = 46 inches, from which we find the circumference of the inner circle C to be 289 and of the outer circle C' to be 345.6 inches (nearly).

Now suppose we propose to use a wedge brick tapering from 2½ to 2 inches, making up any deficiency in alinement with 2½-inch flats.

Let x = the number of wedge brick.
y = " " " flat "
Then $2\frac{1}{2}\ x + 2\frac{1}{2}\ y = 345.6$
and $2\ \ x + 2\frac{1}{2}\ y = 289$
from which $x = 113$ (nearly)
$y = 25$ (nearly)

The proposed arch includes 60 degrees or 1/6 of the complete circle, and we

CHAIN DEPARTMENT

Roller Chains Block Chains
"Wizard" Chains.

MACHINE DEPARTMENT

Hand and Weight (feed) Milling Machines,
20-inch Water Tool Grinders.

MISCELLANEOUS DEPARTMENT.

Keys and Cutters for the Woodruff Patent System of Keying
"Presto" Chucks, Collets and Friction Tapping Devices
Sprockets for "Wizard" Chains
Hartford Printer.

"Presto" Chucks, Collets and Friction Tapping Devices are used in Drill Presses, Turret Machines and Lathes and they make possible the rapid change of Drills, Reamers, Counterbores, Taps, etc., without stopping the spindle of the machine.

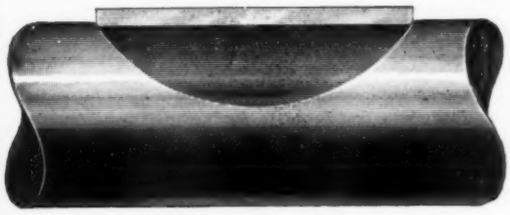
Patented

Detachable Type

Patented

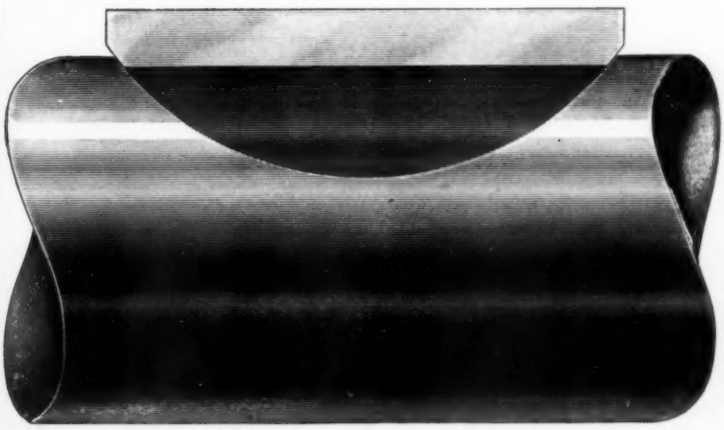
Against claims made by Competitors, we submit the following list ot Motor Car Manufacturers using "WHITNEY" ROLLER CHAINS and STANDARDS. Is it not time for everyone to admit that "WHITNEY" STANDARDS for ROLLER CHAIN dimensions are now the American Standards?

"ADAMS-FARWELL" "AMERICAN MOTOR TRUCK" "AUTO-CAR EQUIPMENT" "BAKER" "BERKSHIRE" "BIDDLE-MURRAY" "CADILLAC" "COLUMBIA" "CHAMPION (McCrea)" "CROWN" "CRAWFORD" "COLUMBUS BUGGY CO." "ELWELL-PARKER" "FORD" "FRANKLIN" "GAETH" "GALE" "GROUT" "HEWITT" "THE HOLMES" "IROQUOIS IRON WORKS" "LAMBERT" "KNOX" "MATHESON" "MACK BROTHERS" "MITCHELL" "MOLINE" "OLDS" "PACKARD" "RAMBLER" "RAPID" "REO" "STEARNS" "THOMAS" "TOURIST" "VECHICLE-EQUIPMENT" "WAYNE" "WESTERN MOTOR TRUCK" "WINDSOR," etc.



The "Woodruff" System is more mechanical, more efficient, and also a great Labor Saver.

The "WOODRUFF" Patent System of Keying



has been adopted by the Leading Manufacturers of Machinery, Automobiles, etc.

THE

WHITNEY MFG. CO.

Hartford, Conn., U. S. A.

Couplings, Shaft—*Continued.*
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.
Witteman & Co., A. P., Phila., Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co. Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.

Cutting Machines—*Continued.*
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.
Swaine Co., Fred J., St. Louis, Mo.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Foote, Burt & Co., Cleveland, Ohio.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Obermayer Co., S., Cincinnati, O.
Queen & Co., Phila., Pa.

Drawing Materials
Keuffel & Esser Co., New York.
Queen & Co., Phila., Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Machine Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.

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Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
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Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., Ohio.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

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Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

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Allington & Curtis Mfg. Co., Saginaw, Mich.

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General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
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Sprague Elec. Co., New York.
Stanley G. I., Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F. Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

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D'Olier & Co., H., Phila., Pa.
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General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
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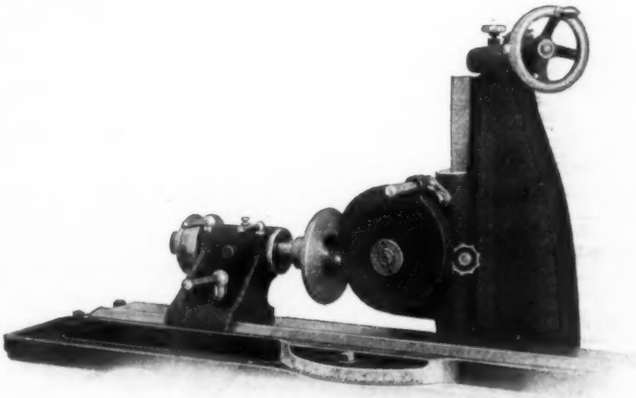
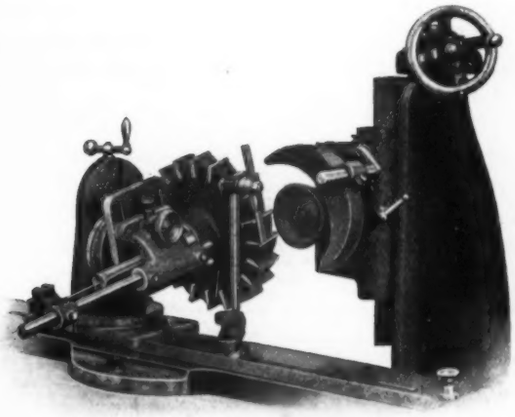
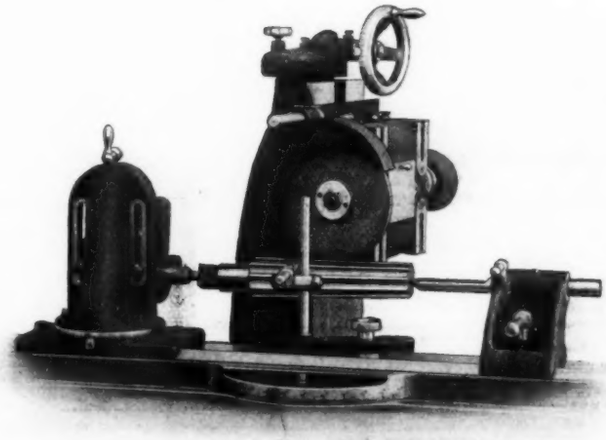
The No. 13 Universal and Tool Grinding Machine

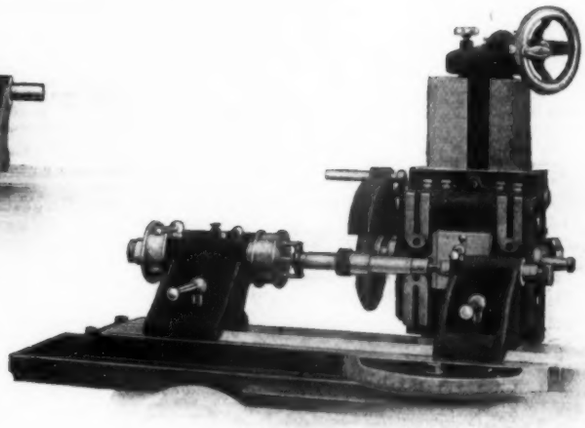
Especially suitable for the Tool Room where adaptability to many kinds of work is essential.



4 of the many varieties of work done on the machine.







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Forgings, Steel
Baldwin Steel Co., New York.
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Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
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Chicago Flexible Shaft Co., Chicago, Ill.
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Gages, Standard
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
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Gould & Eberhardt, Newark, N. J.
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Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
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Taylor-Wilson Mfg. Co., Allegheny, Pa.
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Farrel Fdry. & Mach. Co., Ansonia, Conn.
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Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, Ohio.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Machine & Tool Works, Dayton, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., New York.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
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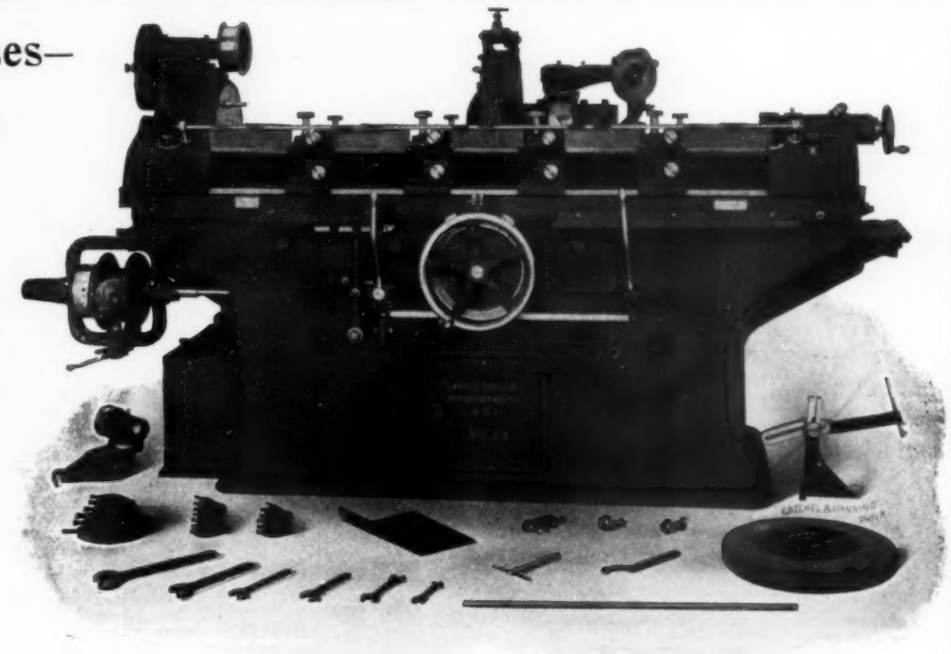

No. 24 Plain Grinding Machine—with automatic feeds. 12-inch swing—66 inches between centers.

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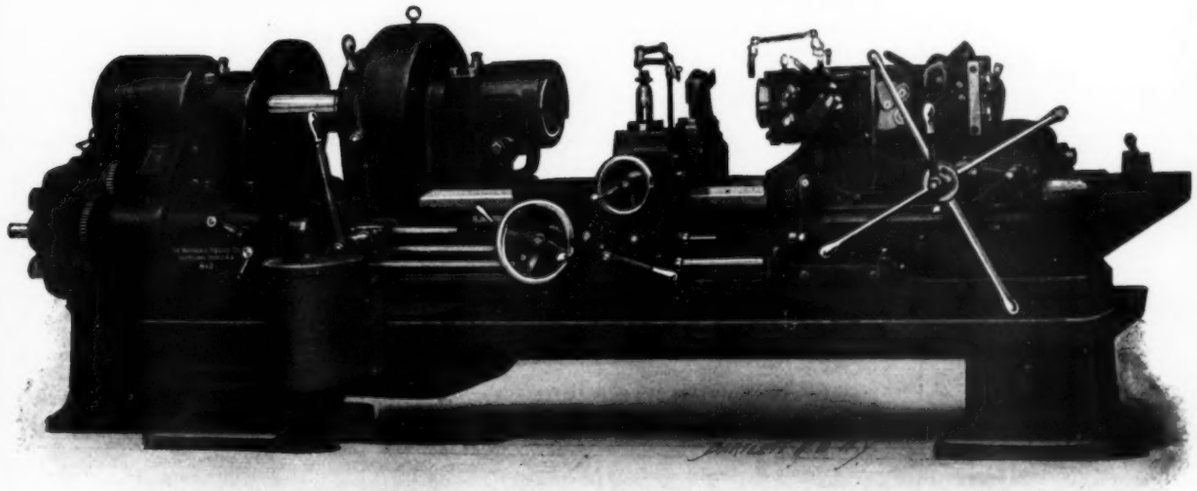

No. 3—3⅝ x 36-inch.

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Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
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Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
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Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Thompson Grinder Co., Springfield, O.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mch. Co., Worcester, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

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Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnat, O.
Diamond Mach. Co., Prov., R. I.
Dwight Slate Machine Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinding and Polishing Machines—*Continued.*
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harringotn, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneumatic Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, Ohio.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Thompson Grinder Co., Springfield, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinding Wheels
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, N. Y.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Pneu. Tool Co., Cleveland, O.
Dayton Pneumatic Tool Co., Dayton, Ohio.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power
Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.

Hammers, Power—*Continued.*
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mchry. Co., Cleveland, O.
Case Mfg. Co., Columbus, Ohio.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Main Belting Co., Phila., Pa.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric
C & C Electric Co., New York.
Case Mfg. Co., Columbus, Ohio.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Case Manufacturing Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Frevert Machinery Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Conn.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel
Sprague Elec. Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Test
Equipoise Rivet Co., Waterbury, Conn.
Norton Emery Wheel Co., Worcester, Mass.
Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

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Davis Machine Co., W. P., Rochester, N. Y.
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Clark Cast Steel Cement Co., Shelton, Conn.

Jacks, Hydraulic
Bethlehem Mdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda
Mfg. Equip. & Engrg. Co., E. Boston, Mass.

Key Seaters
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Machine Tool Co., W. P., Rochester, N. Y.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

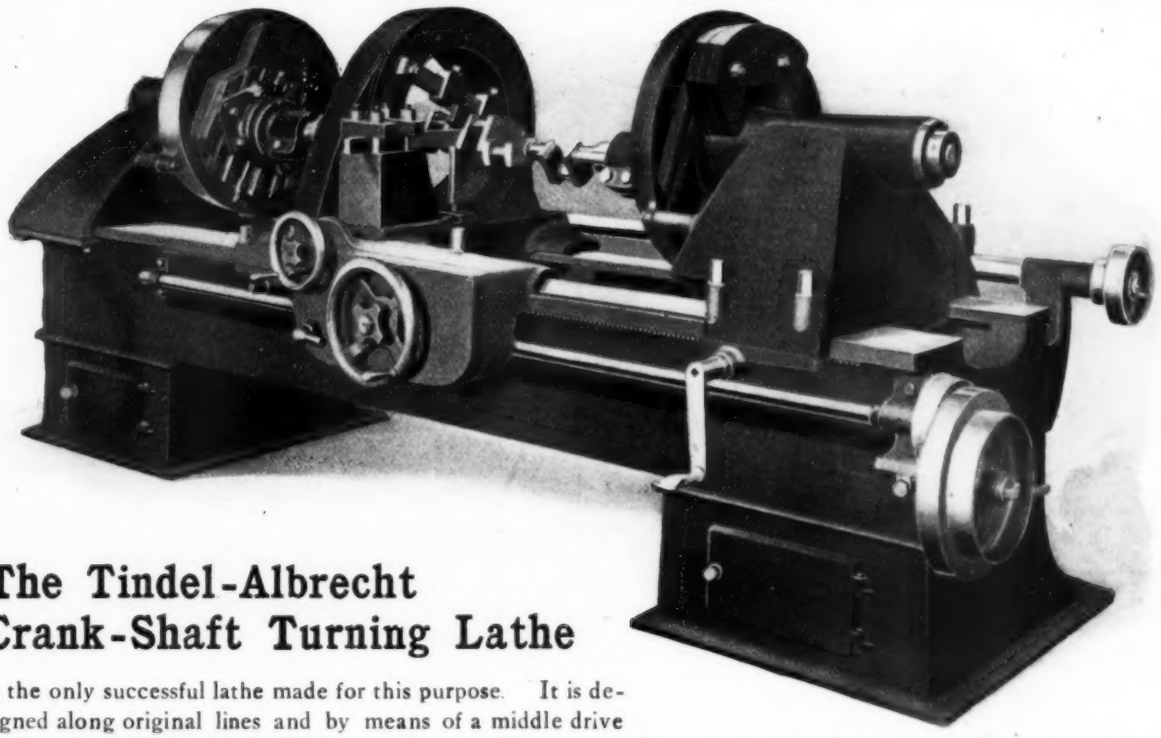
Knives, Shear
Phillips-Laffitte Co., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bowers, E. J., Philadelphia, Pa.
Bradford Machine Tool Co., Cincinnati, Ohio.



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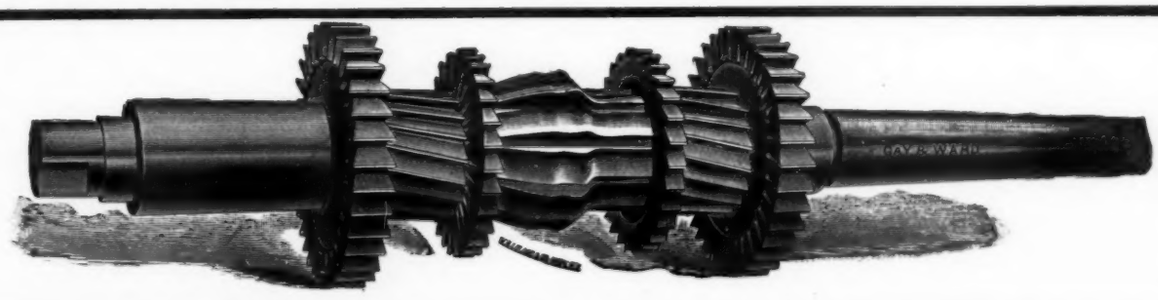

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Seneca Falls Mfg. Co., Seneca Falls, N. Y..
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs
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Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Machine Co., Boston, Mass.
Amercian Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barker & Co., Wm., Cincinnati, Ohio.
Barnes Co., W. F., & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Champion Tool Works Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Providence, R. I.
Dreses Mach. Tool Co., Cincinnati, O.
Fairbanks Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayon, Ohio.
Prentiss Tool & Suply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Wells & Sons, Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.

Lathes, Bench—*Continued.*
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Lathes, Brass
Barker & Co., Wm., Cincinnati O.
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Speed
Blount Co., J. G., Everett, Mass.

Lathes, Wood
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., New York.

Levels
Queen & Co., Philadelphia, Pa.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Electric
General Electric Co., New York.

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Besly & Co., Chas. H., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Dixon Crucible Co., Jos., Jersey City, N. J.

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Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

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Baird Machry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
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McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Cleveland, O.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mach. Co., C. C., Detroit, Mich.

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Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, Ohio.
Hammacher, Schlemmer & Co., New York.
LeCount, Wm. G., So. Norwalk, Conn.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Machinists' Small Tools—*Continued.*
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
U. S. Watch Tool Co., Rochester, N. Y.
Wyke & Co., J., East Boston, Mass.

Machinists' Supplies
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co., Cincinnati, Ohio.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Meters, Electric
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Milling Machine Co., Cincinnati, O.
Hendey Mch. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill, Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin. O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Provdence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Watlham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Milling Mach. Co., Rockford, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Rand Co., New York.

Mixing and Sifting Machines, Sand
Gould & Eberhardt, Newark, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
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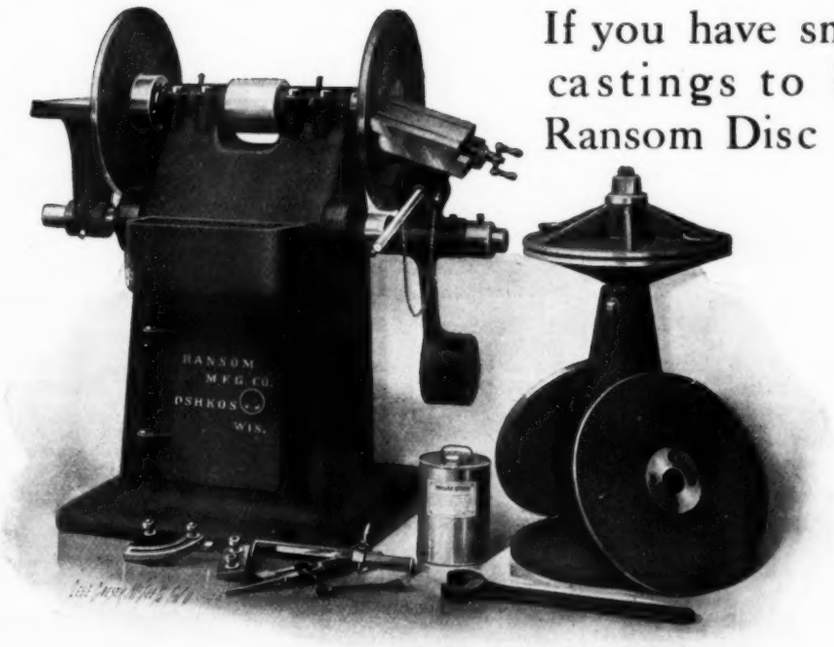

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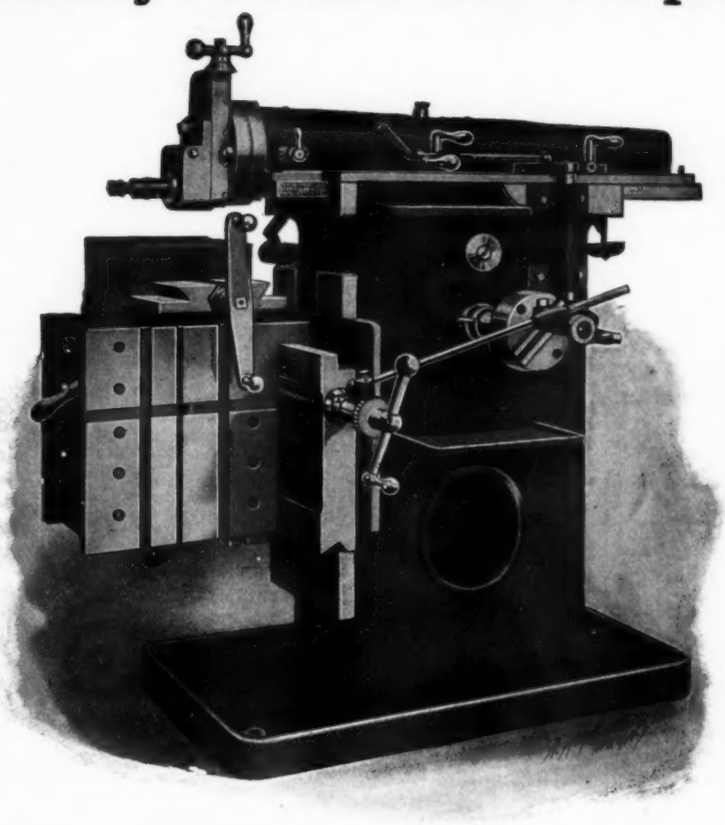

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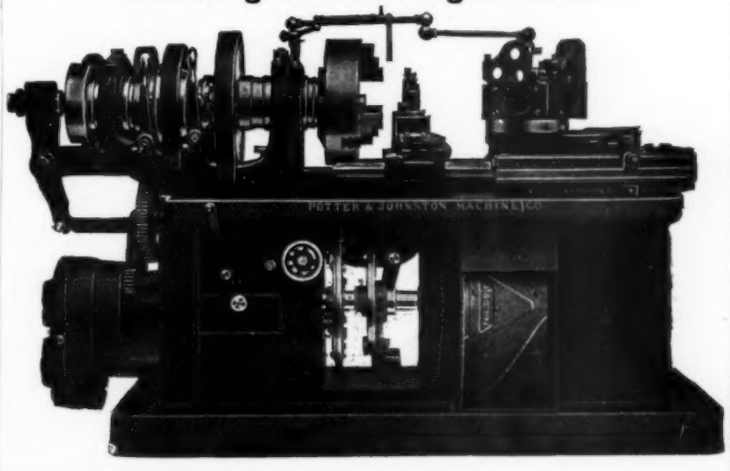

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Soldering Fluid
Elliott Chemical Works, Newton, Mass.

Special Machines and Tools
Automatic Mach. Co., Bridgeport, Conn.
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach Co., The, Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Cleveland Cap Screw Co., Cleveland, O.
Crescent Forgings Co., Oakmont, Pa.
Dexter, Chas. S., Attleboro, Mass.
Elmes Eng. Works, Chas. F., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
Gardner Engineering Co., New York.
Greenfield Steam Eng. Co., East Newark, N. J.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mach. Tool Co., Cleveland, Ohio.
Mueller Mach. Tool Co., Cin., O.
National-Acme Mfg. Co., Cleveland, O.
Natl.Machinery Co., Tiffin, Ohio.
Nazel Engineering & Machine Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Poole Co., J. Morton, Wilmington, Del.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Engineering Works, Ellwood City, Ind.
Walcott & Son, Geo. D., Jackson, Mich.

Spike Machinery
National Machy Co., Tiffin, O.

Spools, Steel
Standard Welding Co., Cleve., O.

Springs, Wire
Cleveland Wire Spring Co., Cleveland, Ohio.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Link-Belt Engineering Co., Philadelphia, Pa.
Whitney Mfg. Co., Hartford, Ct.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Air Hardening
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Stirling Steel Co., Demmler, Pa.
International High-Speed Steel Co., New York.
Jones & Co., B. M., Boston, Mass.
Kent & Co., Edwin R., Chicago, Ill.

Steel, Machinery
Boker & Co., Hermann, New York.
Firth-Stirling Steel Co., Demmler, Pa.
International High Speed Steel Co., New York.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston.
Witteman & Co., A. P., Philadelphia, Pa.

Steel, Sheet
American Tube & Stamping Co., Brigeport, Conn.
Ward & Son, Edgar T., Boston, Mass.

take $\frac{1}{16}$ for the number of wedge brick and $\frac{5}{16}$ for the flats, the results being taken in even numbers giving 19 wedge and 4 flats, exactly as shown in the figure. Any problem involving arch, wedge or circular brick may be worked out in the same manner with results sufficiently close for practical purposes.

In estimating fire-brick work, it is not enough to calculate the number required, as from 5 to 10 per cent. must be added to cover losses in transporting and laying. A brick that is broken squarely in two is a more valuable asset than one that has the corners broken off, as "bats" are often used while a brick that is rounded is worthless for first-class work.

Tables have been presented in engineering pocket-books, giving so-called standard shapes. I have compared these tables with the catalogs of a large number of brick makers, and while the lists may be approximately correct the sizes given are far from being of sufficient accuracy to warrant a designer using them in calculations for first-class work. As the designer selects his gears from the list of the firm he proposes purchasing from, so he should select his fire brick from the list of the maker.

A fire brick cannot be cut as accurately by a mason as it can be pressed by the brick machine, and the designer should aim to use as many intact brick as is possible.

Second-quality work need not be laid up nor calculated with such care, as the brick are not so expensive, nor is the result of so much importance. Furthermore, the second-class work in the rear of the boiler setting will likely outlast the first-quality work in the fire box, and there is no sense in tearing out good work, because the balance of the furnace is burnt. The whole setting should arrive at the same stage of dilapidation at the same time, like the deacon's "one hoss shay."

I have touched on but a few points of what is really a large subject. I have omitted many points worthy of discussion, but I feel sure that those I have brought to notice are worthy of consideration by everyone having anything to do with boiler setting.

The problem of removing the dust and dirt from the subway in New York has been solved, it is stated, by the use of the vacuum cleaning apparatus, a test having been made in one of the stations. It is proposed to equip a car with the apparatus, so that it can be readily moved to different points and enable the whole system to be thoroughly cleaned out.

The use of aluminum in mixtures which are intended to withstand pressure should be avoided, as even a few hundredths of 1 per cent. of aluminum in steam metal will lead to its leaking under pressure.

Letters to the Editor.

Blue-Print Standards for Drawing Room and Shop.

Some time ago a contributor to the AMERICAN MACHINIST spoke reminiscently of a time early in his career when blue-prints were considered a luxury in the machine shop. Until I read his article it had never occurred to me how far we had carried the use of blue-prints in our factory. A visitor to our shop, the master mechanic of a similar institution, remarked on our extensive use of blue-prints, which has led me to believe that there are many other shops which do not carry it so far as we do. This has prompted me to write up our system for your columns. Each step has been added one at a time, and the whole has been developed so gradually that no new feature seemed radical enough to merit any special attention. The present system is the result of the suggestions from all departments of the plant. It has been the custom to regularly hold a shop council, at which the secretary, buyer, superintendent, chief draftsman, shop foremen and all those interested are present. The time of the meeting is set at the noon hour of a stated day of the week, when they all come together and discuss questions of general interest and correct those conditions which by experience have proven themselves to be against the welfare of the plant. As a result of these meetings systems similar to the one described herein are worked out and adopted. There are some things about it which are not wholly satisfactory, some of the essential minor features which some departments find objectionable; but so far it is the best that we know, and certainly much better than that we had formerly used. Of course the evolution continues, and in time those things which are not desirable may be eliminated. No doubt these changes will continue indefinitely. To those who can find fault with the system we would say that the most severe criticism will be appreciated, especially if it is accompanied with suggestions of something better. However, I believe a fair trial will establish a conviction that it has merit. Asked if the use of so many blue-prints is economy, we most emphatically say yes. We consider a scarcity of prints in the shop the acme of extravagance.

Formerly the mounted print was the only blue-print we ever used. If the foreman desired to look up a drawing, it was necessary for him to go to the tool room for this print, to secure his information. The prints soon became battered and broken, in which condition they were very clumsy to handle; especially where there were many of them. It was very hard to keep track of them. If anyone has tried to keep an accurate checking system of these mounted prints, where they have 500 or more to handle, he knows the difficulties encountered.

Now we use no mounted prints of our regular product. Our experience has shown us that it does not pay. Invariably the workman was compelled to go to the foreman to learn the number of the drawing and then make a visit to the tool room to secure it. Often the drawing would not be there, and even though there were duplicates, both would be out. Many of the drawings contain as high as a dozen detached pieces and other workmen would be using them. If one of these workmen were still using the print, the other would borrow it for awhile and probably in turn lend it to another. The worthlessness of a check system in a case like this is evident, and the confusion was very annoying. The next man who wanted that drawing would have a hard time locating it. Instances have been cited in our factory in which a workman has spent as much as half an hour looking through the shop for a blue-print.

So we have discarded the mounted print as a nuisance. The cost-keeping department orders out all work, and a tag is made up stating the number of pieces in the lot, and the symbol number of the piece to be machined. There are spaces on this card for the check number of each man and the time of each operation, thus:

Workman No. 53—Drilling, 4 hours.

Workman No. 86—Planing, 16½ hours, and so on. To this card is pasted a print of that particular piece. When the workman receives the order for the job he has all necessary information. He need not know the drawing number, need not spend any preliminary time for anything, but goes right to work. After the job is finished it is checked with the drawing which the workman used in machining, and no plea of discrepancy in drawings can be made, as had been done before. A new blue-print accompanies each new lot, no attempt being made to use the same prints again. Usually they become so soiled and torn in one round that they are unfit for further use. The same was true of mounted prints, and serious mistakes were sometimes made because the figures had been almost obliterated and were mistaken for something else. An instance of an error of this kind occurred not long ago. A workman had a lot of spindles to grind, the correct diameter of which was 17/64 inch. The 7 and 6 were entirely obscured, the 1 and 4 being just discernible. The dimension then read ¼ inch, and as the print scaled that size and there seemed to be about the proper allowance for grinding, they were finished ¼ inch and the entire lot spoiled.

Blue-print books are made up for each shop foreman and the cost department, each size machine being in a separate book. A book of the No. 4 vertical machine contains all assembly views and detailed prints which pertain to that machine. If some of the details on a draw-

ing are used on this machine, while others on the same drawing are not, those not used are blue-penciled. These books are made up in the drawing room by one who is in a position to know just what parts are used on each machine. This gives each foreman a perfect record of all the details which go with any machine. All stock is ordered by the book, and when a lot of a certain number of machines are to be gotten out, it is an easy matter to learn just what is required for the lot. The books are all bound in a regular order. Thus on a lathe the prints of the headstock and details come first, followed in order by footstock, carriage-feed details and bed. The arrangement is optional, only it is necessary to have the same arrangement for all the books, so that any desired part of the machine may be readily found. Under each head the assembly prints come first, followed by the details.

The enclosed print shows a leaf from our screw book. This is the fourth style of screw book which we have had, and the arrangement is liked by all who use it. The other books were classified by sizes, lengths, etc., but this was not satisfactory.

In the book referred to each style screw has a page or more devoted to that screw only, and two styles of screw are never placed on the same page. The page shown* is for hex. heads only, and the numbers run consecutively regardless of size. Each style of screw has a number limit, hex. heads being numbered from 200 to 400, headless from 400 to 600, and so on. It is hardly probable that more than 200 different screws of any one style will be made; but if so, a symbol letter can be used in connection with the same numbers, and they can be used indefinitely. The book is arranged so that the screws used most frequently come first, while those most rarely used are on the last pages. The fillisters are numbered from 1 to 200, followed by the hex, headless, set-screws, etc.—the hundreds running consecutively. All of our drawings are marked with the number of screw at every plain or tapped hole in which a screw is to enter. Hence the shop always finds a screw by its number. When the workman sees any screw in the two hundreds he knows at once it is a hex head, and so on with all the styles. He turns to the screw book, and as the numbers run consecutively, he can find the desired screw quickly. For shop use the book is as convenient as we know how to make it. For drawing room it is not so handy, for there the sizes are referred to and not the numbers. But the book is used many times in the shop to once in the drawing room. Every foreman and every screw-machine operator is furnished with one of these books.

Prints of tables and data pertaining to this particular class of work are furnished the workmen. The lathe and grinder hands will have tables of standard tapers and decimal equivalents, the drill-press hand a table of U. S. S. threads with tap drills. The tool room is furnished with all data they could possibly have any use for. These prints are mounted on thin boards and varnished so that they may be easily cleaned. The workman hangs them in a convenient place beside his machine, ready for reference.

Naturally all of this blue-printing takes lots of paper and time; but a rapid-printing paper of a grade to last no longer than we have use for them can be had very cheaply. We have a boy printing all the time with both sun and electric-printing outfits, and the results certainly show that it pays. An accurate record of costs shows the cost of the paper and time of printing to be the best kind of an investment.

We do find deficiencies in the system and are trying to overcome them. I hope that our experience may be found useful by some of your readers, and also that it may cause others to write on the subject, that their experience will in turn be helpful to us. L. F. B.

*The blue-print accompanying the article, which it is hardly necessary to reproduce, is 5⅜x8¾ inches and has at the top a drawing of a hex-head cap screw with diameter, length under head, length of thread and distance across flats of head lettered. Below this is a table giving screws Nos. 200 to 212, the lettered dimensions, number of threads, size of tap drill, and a column for remarks.—Ed.

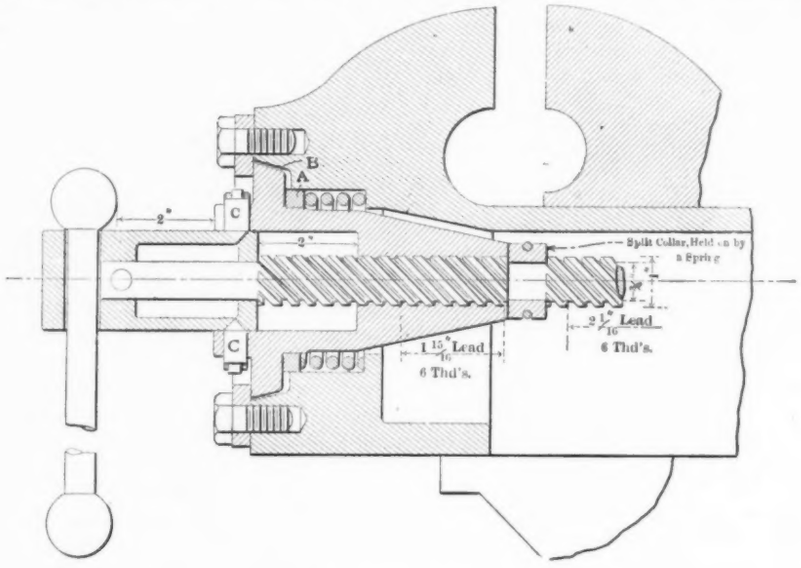
Handling Eccentric Jobs with the Flat Turret.

A possibility with the flat turret lathe which I believe is not generally considered is the fact that with combinations of the different sizes of standard chuck jaws eccentric work, of various degrees of eccentricity, may be produced.

OPERATOR.

Modification of the Differential Screw.

There are two difficulties which have prevented the wide use of the differential screw. These are first, the excessively slow motion of the driven parts and second the inordinate length of screw as compared with the movement obtained, both these difficulties growing out of the fact that the motion obtained is that due to the difference between the pitches which, in the nature of the case, is small. The accompanying illustration shows a vise fitted with a differential screw of my design* by which these difficulties are avoided. The action is such that when opening the jaws or when closing them to take up the slack only one screw acts, the differential action coming into play after the jaws have closed on the work. Moreover the screws being of steep pitch the traverse of the jaws is much more rapid than usual, the action during the traverse being that of a very coarse and during the bite that of a very fine pitch screw.



A DIFFERENTIAL SCREW VISE.

The principle is to hold one nut temporarily fast to the screw during the traverse, letting it act as a thrust collar, motion being transmitted by the other nut; then upon any resistance to said motion, the thrust friction on the first nut stops it from turning with the screw as a collar and holds it stationary as a nut, the screw then advancing through both nuts and all further motion being derived from the difference in pitch between the two nuts.

In the accompanying sketch the collar nut is shown attached to the screw by two spring pins *C C*, spring collar *A* keeping it off its taper seat *B* until the vise jaws meet resistance. This taper seat *B* is not to stop the nut from turning with the screw as a collar, but to stop it from re-

*We understand that the device is patented.—Ed.

versing and revolving on the screw in the opposite direction on account of the very steep angle of the screw. A moderate pitch requires no such taper seat.

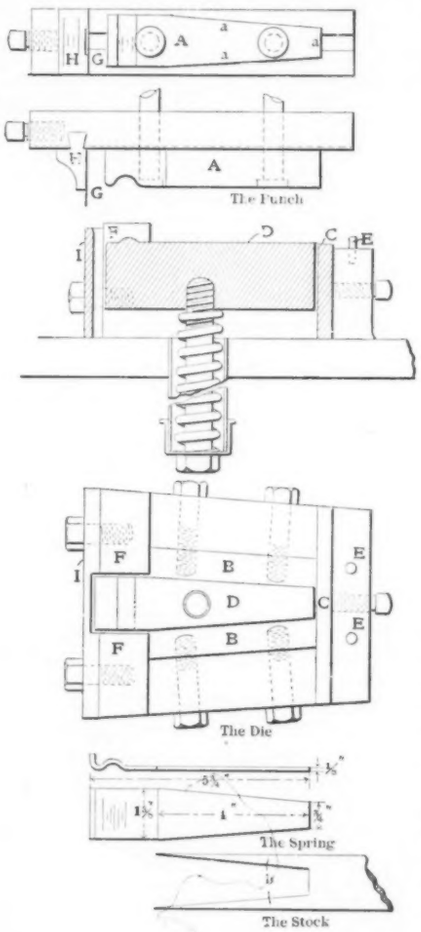
In this vise the jaws advance 2 1/16 inches per turn of the screw until the jaws meet resistance, when the differential action of the 1 15/16-inch pitch collar nut begins, giving a resultant motion of 1/8 inch to the jaws per turn of the screw.

There would seem to be many uses for this novel mechanical movement.

CHAS. R. PRATT.

Press Tools for Blanking and Forming Steel Springs.

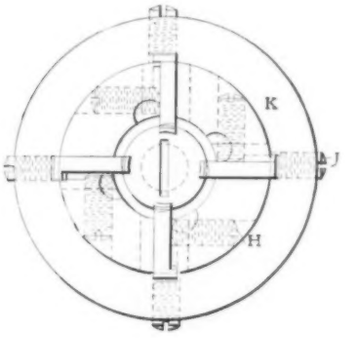
The compound die shown herewith is made of high-speed steel for punching

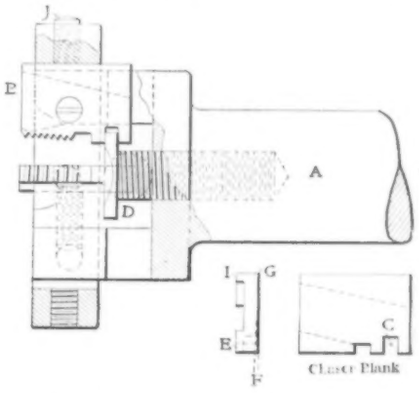


PRESS TOOLS FOR BLANKING AND FORMING STEEL SPRINGS.

and forming hot the steel spring shown in the lower sketch. The stock, which comes in strips long enough for eight pieces, is about 0.65 carbon and is worked at a red heat. The punch *A* is made of Blue Chip steel bolted to the holder (partly shown) and cuts along the three edges *a a a*, the rest of the spring being the full width of the stock.

The die proper is also made up of three cutting edges, the side pieces *B B* and the end piece *C*, all being of Blue Chip steel; the pieces *B* are given about 1/8 inch shear, being high in the middle and tapering to the ends. *C* is left straight and adjusted to the hight of the ends of *B*; any difference in the hights at the junctions of these three parts shows up on the stock, and consequently on the loop of the spring, as will be understood later. The piece *D* is of machine steel, and combines the functions of former and knockout, assisted by the pipe, cap, spring and bolt. The pins *E* and spots *F* locate the stock sideways, and the gage *G* on the punch holders locates it lengthwise. On all but the first stroke of the press the two prongs *b* on the stock must be cut off, which is done at the beginning of each stroke by the trimming knives *H* and *I*. The gage *C* and the cutting edge of *H* are flush and *G* projects below the edge of *I* making a gage that cannot be missed; it is also just as wide as the flat space between the prongs *b*, thereby centering the stock independently of the lugs *F*. *G* must be central or





TAPER THREADING DIE.

one edge of the taper will be longer than the other. The cutting edge of *H* is set 3/16 inch lower than that of *A*, as the prongs must be cut off before the punch *A* begins to cut or the stock will be bent over *I*, and the bend will show up in the spring. As will be noticed *I* is somewhat higher than *B* and *C*, so as to hold the end of the spring over the round end of the punch and form the loop, and its hight helps to form the loop before the die begins to cut, so that the punch need not enter the die much further than to do its work. As the length of the straightened spring is only about 1/4 inch more than when formed, this leaves the piece *I* very thin, that is, 3/16 inch; the other 1/16 inch is drawn into the hump from the long taper part, which helps the knockout wonderfully, making the spring smaller than the die, and therefore easy to extricate.

Scale gives us much trouble sometimes by getting into the spring and in the knockout pocket. A greater abomination is a hot die opening enough to bur the work. Most of our large forming dies must be corrected for heat as they otherwise tear the stock, and then they must be warmed up before using or they tear the stock until they get warm.

WM. H. BROOKS.

A Taper Threading Die.

The illustration shows an adjustable and relieved turret die which I designed for cutting taper threads on brass connections for water meters. The adjustable feature of the die is necessary for cutting the various diameters of threads adopted by some water-supply companies as a standard for their connections. In some instances the diameter of the thread varies considerably either above or below that of the regular or most common standard for meter connections. To cut these threads with a non-adjustable, deep die, by running it on a certain distance in order to obtain the desired diameter at a given distance from the end, would leave them out of proportion as to length.

The die is easily adjusted and, being relieved, it cuts freely and leaves a clean and smooth thread. The body *A* is made of machinery steel. Its head contains four slots with inclined shoulders to receive the die blades or chasers *B*, the slots being cut so that the cutting sides of the blades are tangent to a circle equal to 1/6 of the diameter of the thread to be cut. The blades, after being fitted to the slots, and ready for boring and threading, appear as in the detail. The slot *C* is milled to a snug fit for the head of the adjusting screw *D*. The projection *E* is cut away after the threading, its purpose being to take up the spring of the threading tool. The backs of the blades are then milled at an angle of 0.01 inch to the inch, as shown exaggerated at *F*, the angular cut being taken parallel with the edge *G*, so that when put in place with the binding screws *H* tightened, the blades are tilted backward, thus forming the relief for the thread. The shoulder *I* is made a trifle narrower than the shoulder in the slots to permit the tilting of the blades.

With the aid of the adjusting screw *D* the blades are moved along the inclined shoulders for adjustment and the set-screws *J* in the machinery-steel collar *K*

hold them to their seats on those shoulders.

A number of these dies have been in use during the last 16 years in the works of the National Meter Company, of Brooklyn, N. Y., for cutting the taper threads on brass connections for the various sizes of water meters made there.

H. E. R. MANBRAND.

The Newall Measuring Machine.

As the person responsible for the design of the Newall measuring machine, I was naturally greatly interested in Professor Sweet's criticism at page 172 and desire to correct a misapprehension that has occurred. Referring to Figs. 3 and 4 of the above-mentioned article (reproduced herewith), Professor Sweet has assumed that the screw and nut of the machine are as shown in Fig. 3, and, in order to obtain an equal length of wearing surface on the nut and screw so as to maintain the pitch, suggests that it should be as shown in Fig. 4; and it is on this point that the mistake has occurred, as the nut and screw are actually as shown in Fig. 5. From this it will be seen that the same effect is obtained as suggested in Fig. 4; as, for a length equal to *D*, the flat face of the screw is relieved, so that this portion of the screw is never in contact with the nut. The length *E* of the screwed portion of the nut is the same as the length *F* of the effective portion of the screw. The screw has a forward movement equal to twice *G*; therefore, when the screw is in mid-position, the full contact is attained. The relief of the front end of the screw, as shown in *D*, is of course quite easy to obtain, and the result is practically a reduction in diameter of the thread at this portion of the screw.

The idea was originally sketched out *exactly* on the lines suggested by Fig. 4, and the reasons for not adopting it were that it necessitated a reduction in the diameter of the spindle, which was undesirable, and also increased the length of the spindle (the relative lengths of Figs. 3 and 4 show the proportion of increase), which was inconvenient. On the other hand, the design adopted necessitated little or no alteration to the existing tools, patterns or fittings. In justice to my critic it should be said that there was nothing in the description of the Newall machine at page 734, Vol. 28, part 2, to enlighten him on this point; but a reference to the previous description that appeared at page 965, Vol. 26, will show that the principle of equal length of screw and nut, as originally propounded, I believe, by Professor Sweet, was employed; and, I may add, no reason has been found to necessitate a departure from this principle.

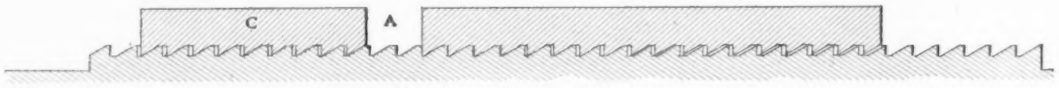


FIG. 3

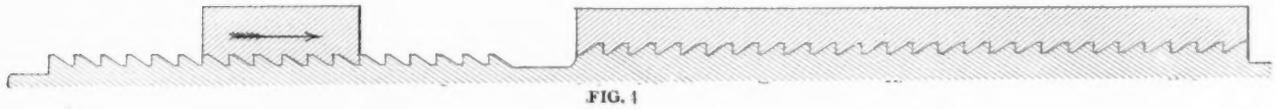
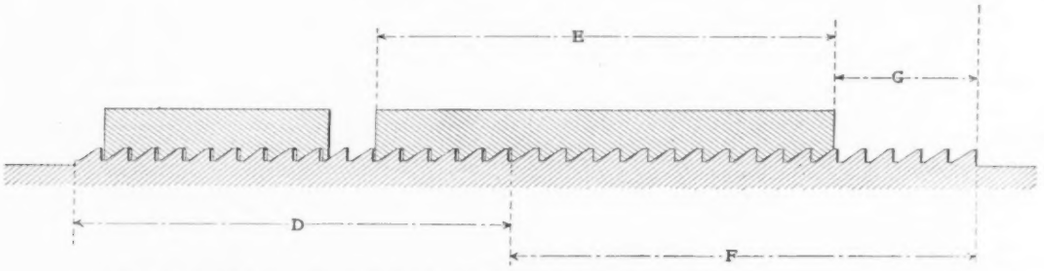


FIG. 4



THE SCREW AND NUT OF THE NEWALL MEASURING MACHINE.

I cannot agree with the statement that no adjustment is necessary for a measuring-machine screw when used on end measures only; it may not be necessary when measuring to 1/1000 inch or so, but when dealing with 1/100,000 inch it is absolutely essential, if only for the purpose of preventing particles of dirt entering between the effective faces of the screw and nut, and for regulating the thickness of the film of oil. The spirit-level device fitted to the Newall machine, although of such a sensitive nature, has worked so well that it is necessary to overcome the imperfections of a screw movement as far as possible. The film of oil between the faces of the screw and nut varies with the speed at which the spindle is advanced, and it does not take much oil, or anything else, to measure 1/100,000 inch. The spring-tension adjustment greatly minimizes the chance of variation from these causes. It is vastly superior to a positive adjustment, inasmuch as it maintains a uniform contact pressure, no matter how much the screw may wear; whereas, with a positive adjustment the tension is gradually and continually decreasing, necessitating frequent readjustment, and it can be demonstrated on a Newall machine in a manner that will not permit of contradiction that an alteration in the pressure will appreciably alter the pitch of the screw—or, it would be more correct to say, have an effect on the measurements obtained equal to an alteration in the pitch.

Professor Sweet expresses the opinion that screws ought to be produced sufficiently accurate to dispense with the device for compensating for the error in the pitch; but he must have overlooked the degree of accuracy required and the severity of the test to which a screw is subjected when using it as a measuring screw. Even with an *absolutely* accurate lead screw (if such a thing is producible) it is not possible to reproduce an equally perfect one from it. I have found that by the exercise of the greatest care screws can be cut on a lathe, with an accurate lead screw, correct within 0.0002 inch; but a closer degree of accuracy than this, although sometimes obtained, is not to be depended upon, owing to uncontrollable variations. As this amount of inaccuracy is too great for this purpose, lapping has to be resorted to. Lapping a screw, after a certain point, is like blind-man's buff, and it is surely better to use the crest of an independent screw for obtaining the correction in the manner adopted on the Newall machine than to attempt the correction on the measuring screw itself.

If it is intended to be implied by the statement that this screw-correcting device is a modification of that used on the Cornell measuring machine of 1873, or that the design was taken from that source, it in an error. I was not even inspired by it, as I have never seen the Cornell machine, to my knowledge, nor a description of it in any shape or form.

I should like to have particulars of the Cornell machine.

As far as I have been aware the only points on which Professor Sweet can

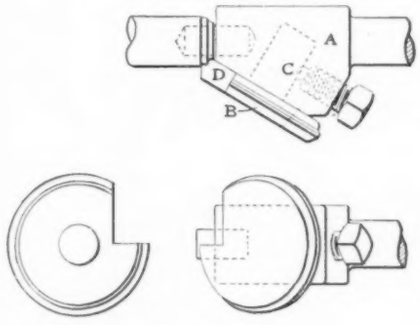
claim priority are the equal lengths of wearing surfaces, and the buttress thread as used on his bench micrometer. The former is a general principle, not a personality; and as for the latter, surely Professor Sweet does not claim a corner in the buttress thread (or ratchet thread, as you call it), which I, for one, would like to see used as commonly as a V thread.

Warrington, England. J. E. STORY.

[We should add that the Cornell machine was the first to stand on three legs and the first to have a device for compensating the error of the screw, this device acting by causing the screw to turn a little more or a little less than the nominal amount. This is exactly the principle of the Newall correcting device, although the construction was entirely different. The screw and nut were lapped, not with a view to correcting their over-all error but to make them alike and a fit, after which the compensating device corrected the remaining error.—Ed.]

A Turret-Lathe Tool.

The drawing herewith illustrates a turret-lathe forming tool designed by me for making ball-bearing cones. The object in devising this tool was to obtain a very rigid affair that would turn out work accurately and in large quantities. Another



A TURRET-LATHE TOOL.

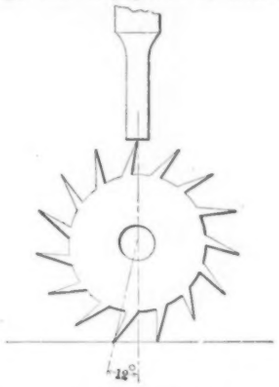
object was to be able to grind the cutting tool readily without changing the size of the finished work.

The stock operated upon was round tool steel in the bar and the duty on the cutting tool was quite severe. In making the cones a hole was first drilled into the bar, after which the forming tool, having a supporting pilot to enter the drilled hole, turned off the outside and formed the ball seat; then a tool on the cross slide cut the cone off to the right thickness ready for tapping. In the drawing *A* is the body of the tool, which has a shank adapted to fit one of the holes in the turret. One side of the body is beveled to an angle of 30 degrees, with the axis of the shank, and at right angles to this side is formed the hole to receive the shank of the circular tool *B*, which can be readily taken out and sharpened without changing the size and shape of cut. The shank of the cutter is securely held by means of a clamping screw, with a concave disk *C* interposed between the end of the screw and the shank. The pilot inserted in the forward end of the body is of tool steel, hardened and ground.

More rake could have been given to the cutter had it been desired, by inclining the upper part of the side *D* toward the center of rotation and consequently inclining the hole for the cutter shank; but this was not found to be necessary in this particular tool, which gave satisfaction as long as these cones were made. C. D. KING.

Finding the Diameter of a 15-Tooth 'Scape Wheel.

The impossibility of measuring a three-flute tap with a micrometer, which has been recently discussed in your columns, brings to mind a job I did a number of years ago that may prove of interest. A



FINDING THE DIAMETER OF A WHEEL HAVING AN ODD NUMBER OF TEETH.

clock of rather unique design had been in a dismantled state for a long period, when I had a request to put it in commission again and make what repairs were necessary. As this clock was valuable mainly on account of the associations connected with it, I had to leave it as near as possible with its original features unaltered.

One of the parts that needed renewing was the 'scape wheel. This was a rather delicate affair, and had the points of the teeth bent in an irregular fashion, as the result of improper care, so I had to make a new one exactly the same diameter as the old one originally was, in order to use the old escapement, which was in good order. As this wheel had 15 teeth, I could not very well get a direct measurement for the size of the blank, but I think I obtained a very close approximation to it by an indirect method.

By standing the old wheel up on the anvil of a vertical micrometer, resting it on two of its teeth, as shown in the sketch, the measuring screw could be brought in contact with the tooth diametrically opposite the space between the two teeth on the anvil, and a measurement taken, which would be less than the blank diameter by the versed sine of 12 degrees (half the angle included between two adjoining teeth). By bringing each tooth in succession to the top, the wheel could be measured in fifteen different directions, which would vary slightly, owing to the fact that the teeth were bent a little, but the mean of these measures should be what the wheel would measure were the teeth in their original shape. One tooth was so badly bent that the three measures in which it was involved were rejected, and the mean of the other twelve measures was taken as the correct value and found to be 0.732 inch. Consulting a table of natural sines, the cosine of 12 degrees was found to be 0.97815 which subtracted from 1 gave 0.02185 as the versed sine. Multiplying this by 0.36 inch, the approximate radius of the wheel, we get 0.008 inch, the amount to be added to the micrometer measurement in order to get the diameter of the blank.

At first sight it may appear like a vicious principle that we must know the radius of the wheel before we can determine the value of the correction in question, but we only need to know the radius approximately in order to determine the correction very closely, an error of 1/20 inch in the assumed value of the radius producing an error of only 0.001 inch in the value of the correction.

WALTER GRIBBEN.

The Action of Lathe Spindles.

In the AMERICAN MACHINIST at page 389, Professor Sweet, referring to my threading and forming tool, states that he should not expect the running of the lathe reversed, with the cutter upside down, so as to hold the spindle down in its bearings, to work well in practice, at least not in all cases.

In very small lathes, where the tension on the belt lifts the spindle, there may be cases where the running of the lathe in this manner may cause chattering, but in three years' actual practice on lathes from nine inches up in size this has not been found to be the case.

It is further shown that Professor Sweet's idea of the wear on the lathe journals is not correct, for the bearings of the spindle show more wear on the bottom than on the top; in fact, the belt is not run tight enough to cause appreciable wear on the upper side of the bearing on account of the large amount of power and wear and tear on belting and machinery which would be wasted, and the machinist could not shift the belt on the cones, which he has to do very frequently, without entailing considerable trouble.

I do not wish to enter into a discussion as to the causes of chattering in lathes, but cannot let pass unnoticed his remarks which would lead to the opinion that my tool causes, or even admits chattering, when I know positively, from personal experience with different sized lathes that such is not the case. When the tool is used in the manner mentioned it not only does not cause chattering, but does cause the lathe to run much smoother

and better than when taking a cut with the lathe running forward.

As for taking up the lost motion in the spindle journals it would mean a job for the shaper every week, and the competition in the machine business of today prohibits the loss of even two or three hours when the remedy is not a remedy. The spindle journal *must* run free, and lost motion is the result. Any lost motion in the slide rest can be taken up instantly, and my theory as proven by practice will do the rest.

Professor Sweet may readily disprove his own assertions by applying a square-nose cutting-off tool while the lathe is running backward. O. G. SIMMONS.

Notes on the Cam Chart.

I was much interested in the article by Mr. Roy at page 335, and hope the discussion will continue. In defense of my methods I would say that I quite agree with Mr. Roy that a chart with separate base lines is much easier to follow than one that is laid out from one base line, but I prefer the latter, as it takes up much less room, and, being thoroughly familiar with the subject, it does not confuse me, especially as I use different colored inks, broken and full lines to denote the different cams on the chart. As to sticking to one machine for a cam chart that would be impossible, as no two machines are alike, even if they are to make the same article of different sizes.

Time spent on the chart is well spent. What is worth doing at all is worth doing well. The rule of thumb is entirely out of my line. Mr. Roy speaks of three weeks spent on the chart which was illustrated in the AMERICAN MACHINIST, and says that some drawings have to be in the shop in that time. But there is a difference between a machine that has 18 cams and costs twelve to fifteen thousand dollars, and a crude machine that costs perhaps five to eight hundred dollars. When I make a chart I want to know exactly what position each cam has to the others in every degree of revolution, even if I could join two arcs by a straight line in some cases, which I do not approve of, when there is a much better way of doing. Moreover I think it poor advice to give beginners. Those who are familiar with the work can take liberties which a novice should not do. As to a short system, I do not know of any but the right one. Some short systems go a long way around, such, for instance, as putting the blanks on their shaft and marking off where the actions are to take place by rule of thumb, only to find when the the full revolution has been made that the time is short, and it is necessary to go over the operation again and, after cutting the cam wish it had been made a little differently. I have been through that experience myself and know whereof I speak.

Mr. Roy also says that it is not practicable to make some cams of thirty degrees angle, as they would be too large. I have had a great many years' experience, but I never found this to be the case. I always make a cam large enough to do the work properly, and design the machine accordingly. I have never run into any trouble with large cams at high speed, but I have had trouble by having too small cams before I was as familiar with the subject as I am now. That was some years ago, and I often wonder why I did not see the cause as plainly as I do now.

Because a machine goes through its actions it does not necessarily work commercially. If it works hard and can be improved upon it is not good enough; the best is none too good.

My method of locating the keyways is not at all slow. It takes longer to tell how it is done than to do it. The method of setting each cam by a set-screw and trying the machine for each operation until they are all set often results in finding when the last cam is reached that some of them have slipped, and the set-screws, being often inaccessible and in different positions cannot be readily reached. This is a common occurrence when following the rule of the thumb. When I have my keyways located I am sure every cam will be in time as laid out as I spend time on the right end of the work. The place to do the designing is on the drawing and not in the shop. It is false economy to rush drawings through for the shop and leave them to work out their own salvation.

I have never used cams with cast pathways and never will, no matter how large the cam may be. I find it cheaper to cut a cam of any reasonable diameter from solid stock, than to make a special pattern and then trim up a cast pathway. I would never lay out a cam chart on a reduced scale as it would make more work in the end, and I prefer to have a check for the cam drawing proper when finished. Dimensions are unnecessary by the system that I use, as the cams are laid out full size as accurately as possible, and zinc templets are taken from the original drawings. This should be done as soon as possible after the drawing is finished, as the weather conditions affect the paper. To make the drawing direct upon the zinc consumes too much time, and is unnecessary.

My experience with cams is not occasional like that of most designers and draftsmen, but I deal with them every day, year in and year out, and have done so for several years, though I feel but an infant learning to creep.

Mr. Roy need not be at all startled because one of his young men tried to lay out a cam by the system I use, as he would not have gone far wrong; but I do not wish him to think that I set myself up as an authority. The articles that appeared in the AMERICAN MACHINIST were for the benefit of those who are not as familiar with the subject as they might wish. They were written with the feeling that I could be of some benefit to them through my experience, and perhaps that others could add to it, in which I have been very much disappointed, showing that cold type do not have an effect upon a great many or they would dispute my statements if they had better or more simple ways of solving the problems. Of course everybody has the right to use his own system, and in the present state of the art there are no set rules to follow, though I hope to see them established some day.

I would like to see tests made to find the power required at different angles of action and on different diameters of cams, also the diameters of rolls best adapted to various loads and angles and diameters of cams, as well as the limit of depth of roll. I have never had the opportunity or financial resources to extend my researches further than I have already described in the AMERICAN MACHINIST, and I hope that some day the colleges take up the subject. I would be only too pleased to give them such information as I possess. I hope to see the day when the subject will be reduced to an actual science, like gearing and power transmission. As the years pass by automatic machinery is coming more into general use and should be understood as much as machine tools. The subject of double cams will be taken up by me later on. I would have done this before but for lack of time to make the necessary drawings.

C. F. SMITH.

Chuck for Holding Thin Pieces for Grinding.

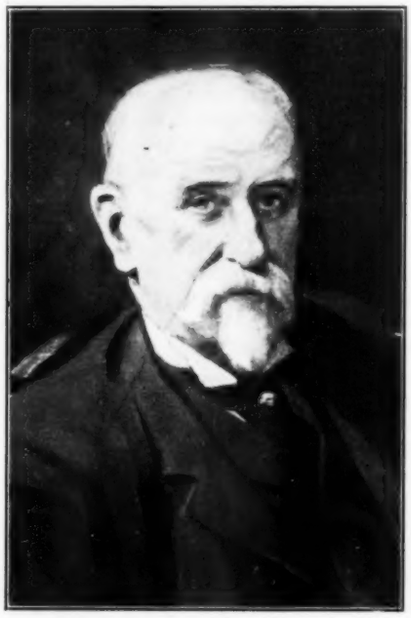
I can indorse every word of what Elmer G. Eberhardt says with regard to the chuck shown at page 62. I have used one like it on our Landis grinder almost every day during the past four years and find it eminently satisfactory for grinding thin milling cutters, washers for ball races, etc., as it pulls them flat to the face plate. Instead of a handwheel at the back we use a nurled disk 2¼ inches in diameter; we can grip tight enough with this to prevent the work from slipping. We use one gripping sleeve only for every size of hole, and have a set of adapter washers to fit the sleeve, and which can be made very cheaply to fit any size of hole. These have four saw slits cut in from the periphery. One saw groove is cut clear through to the bore; the other three are cut within 1/16 inch of the bore, which allows the washer to expand when the chuck is opened by the tapered end of the spindle, and the whole thing is then drawn tight up against the face plate. GRINDER.

H——, England.

The Chattanooga meeting of the A. S. M. E. promises to be unusually interesting and also unusually well attended. All should go who can.

John C. Kafer.

John Christian Kafer, past president of the Engineers' Club, and whose death at Trenton, N. J., on March 30 was announced in our last issue, had been in poor health for the last two or three years. He was born at Trenton, December 27, 1842, and at the outbreak of the Civil War was engaged in engineering studies and work. He was appointed third assistant engineer in the navy in 1863 and on April 15, 1865, the morning of President Lincoln's death, he sailed for the Mediterranean on the famous "Kearsarge," whose executive officer was Lieutenant-Commander George Dewey. From this time until 1885 he was at various periods attached to different vessels, and during the term of Commodore Loring as chief engineer of the navy Mr. Kafer was his first assistant. He served in a similar capacity under Admiral Melville when the latter became engineer-in-chief. He taught in the Naval Academy from 1868 to 1874, and from 1878 to 1882, and during his terms of service made two tours of duty, when many classes of cadet engineers and midshipmen were under his instruction. In 1885 he became associated with the Morgan Iron Works of New York City, serving as vice-president, superintendent, secretary and treasurer. He then became connected with the Quintard Iron Works, and within the past month had organized the consulting firm of Kafer, Mattice & Warren.



JOHN C. KAFER.

Mr. Kafer was one of the most active members of the Engineers' Club from its foundation, serving for years as vice-president and chairman of the house committee and as president from 1901 to 1904. He also served as a member of the board of managers of the American Society of Mechanical Engineers, of which he had also been vice-president. At the time of his death he was the senior American member of the Institution of Naval Architects of Great Britain, a member of the American Society of Naval Engineers, the Society of Naval Architects and Marine Engineers, and of the Engineers', Army and Navy and Players' Clubs, New York City. It was largely through his instrumentality that the gift of $1,500,000 was secured from Mr. Carnegie three years ago for the United Engineering Building and the Engineers' Club.

A month ago a portrait of Mr. Kafer from the brush of Orlando Rouland was presented to the Engineers' Club by a number of his fellow members and friends. The half-tone likeness is reproduced from a photograph of this painting.

Program for the Chattanooga Meeting of the A. S. M. E.

In the program for the spring meeting of the American Society of Mechanical Engineers, to be held at Chattanooga, Tenn. May 1—4, 1906, it is announced that the headquarters will be at the Read House and the professional sessions will be held in the assembly hall of that hotel.

Mayor W. L. Frierson will, on Tuesday evening, May 1, deliver an address of welcome, which will be responded to by the president of the society, Fred W. Taylor, and a social reunion will be held on this evening. On Wednesday morning at 9.30 the business session will be convened, and after the completion of executive business the following papers will be presented:

Report of committee on Standard Proportions for Machine Screws.

Report of committee co-operating on Pennsylvania Railroad Locomotive Tests.

Professional paper "Effect of a Blow," by A. W. Moseley and J. L. Bacon.

On Wednesday afternoon there will be an excursion to the Chickamauga-Chattanooga National Military park on Chickamauga battlefield and the United States Army Post. A carriage drive will be taken over the battlefield and park, giving an opportunity to see the hundreds of monuments and historic tablets. This will be followed by a regimental drill by the Twelth United States Cavalry.

On Wednesday evening at 8.30 the following professional papers will be presented:

"Low Resistance Thermo-electric Pyrometer and Compensator," by Wm. H. Bristol.

"Manganese Steel," by Henry D. Hibbard.

"A History of the Introduction of a System of Shop Management," by James M. Dodge.

"Collapsing Pressures of Bessemer-Steel, Lap-welded Tubes," by R. T. Stewart.

"New Liquid Measuring Apparatus," by George B. Willcox.

The closing session will be held on Thursday morning, May 3, at 9.30. The principal matter of discussion will be Water-Wheel Governing, and a number of short papers will be presented, to be followed by general discussion. Among those who will present papers on this subject are: Mark A. Replogle, Geo. A. Buvinger, John Sturgess, and Geo. J. Henry, Jr.; and a number of others have also signified their intention of discussing the subject orally.

The following professional papers will then be presented: "Efficiency Tests of Turbine Water-wheels," by Wm. O. Weber.

"The Improvement of the Tennessee River and Power Installation of the Chattanooga and Tennessee River Power Company at Hale's Bar, Tenn.," by Thos. E. Murray.

On Thursday afternoon at 2 o'clock there will be an excursion to Lookout Mountain by trolley and incline, from which will be viewed the city of Chattanooga, the windings of the Tennessee river, the Cumberland and Blue Ridge mountains, the battlefields and the whole historic panorama.

In the evening the local members of the American engineering societies, together with other citizens of Chattanooga, will tender a reception, at the Read House.

On Friday morning there will be an excursion for members and ladies to Missionary Ridge and other points of interest about the city; also another excursion at the same time for members to industries about the city.

On Friday afternoon there will be an excursion by the steamboat "Chattanooga" on the Tennessee river through the mountain section below Chattanooga to Hale's Bar, 33 miles by river, where a dam is being constructed to aid navigation, and which will furnish 50,000 horse-power to the factories in Chattanooga, 12 miles away in a straight line. The return trip will be by the N. C. & St. L. R. R. from Shellmound, where the party will leave the boat.

Those intending to attend the meeting are advised to consult Thos. E. Murray's souvenir book on Chattanooga.

Chas. A. Francis, of the mechanical engineering department of the Higher Technological School, of Tokyo, Japan, sends us a clipping from the *Japan Times* of March 7, according to which Messrs. Armstrong & Company, the well-known engineering firm of England, have secured a considerable tract of land in Japan and will erect there a very large works, the estimated cost being about 50,000,000 yen, or about $25,000,000. This seems rather a large enterprise, and there may be some exaggeration in the cost; but, at any rate, it seems clear that something important is to be done. Mr. Francis expresses the opinion that our American manufacturers ought to be doing similar things in Japan, and hopes they will be brought to see the importance of it.

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Contents.

	PAGE
Automatic Multiple Punching Machine	469
Designing a Boring Mill	472
Thrust Bearing and Commutator for Gasolene Launch Engine—A Correction	477
Automobile Construction—IX	477
Works and Methods of Alfred Herbert, Ltd., Coventry, England—I	478
Museums of Security	482
Fire-Brick Work	483
Letters to the Editor: Blue-Print Standards for Drawing Room and Shop....A Modification of the Differential Screw....Press Tools for Blanking and Forming Steel Springs....A Taper Threading Die....The Newall Measuring Machine....The Action of Lathe Spindles....Notes on the Cam Chart....Chuck for Holding Thin Pieces for Grinding	485-490
John C. Kafer	491
Program for the Chattanooga Meeting of the A. S. M. E.	491
Fire Protection in Steamboats	492
Government Report on Some Live Subjects	492
New Publications	493
New Tools and Machine Shop Appliances	493
Report on the Government Fuel Investigations—Formation of a "National Advisory Board"	494
Thomas Richard Almond	494
The Delivery of Coal by Means of the Chicago Freight Subway	494
The Metric Situation	495
Making Cast-Iron Frames for Electrical Instruments	497
Personal	498
Obituary	498

Fire Protection in Steamboats.

The position taken by our contemporary, *Engineering News*, with regard to the burning of the Fall River Line steamer "Plymouth," will we think be generally indorsed. It is as plain as anything can well be that, had such a fire broken out on any night when the "Plymouth" was in service, it would have added one more to the world's great horrors. As it was, with the boat tied up to a wharf, one man, employed upon the boat and presumably more or less familiar with it, could not get off in time and lost his life.

The fact is that the "Slocum" horror may be repeated or surpassed any night upon Long Island Sound.

True, the hulls of the boats are of steel but the towering superstructures are of the most inflammable materials, and to secure ventilation are so arranged as to afford every facility for the most rapid spread of a fire. If such a boat can burn so rapidly that a single man, with no one to look out for but himself, with no crowd to contend with and no panic, could not save himself from a burning boat tied up to a wharf, what would be the fate of a thousand people of both sexes and all ages, wakened on a windy night with the boat in the middle of Long Island Sound?

The superlatively wealthy corporation—the New York New Haven & Hartford Railroad Company—owns the Fall River and Providence lines of steamers; we wonder if it will, in view of the "Slocum" horror and the exceedingly rapid burning of the "Plymouth," take the responsibility of rebuilding upon the still serviceable hull of that vessel another tinder box in which to convey many hundreds of sleeping men, women and children every night of the summer months? And if it does do this we wonder just how the way will be found to clear the responsible officers of all guilt when the almost inevitable disaster occurs.

We wonder if anyone connected with these steamboat lines has ever considered the application of automatic sprinklers to those boats. There would appear to be no good reason why they cannot be used on boats to save both lives and property as well as in buildings where the object is generally to save property only and where from that standpoint alone they pay in dollars and cents, as reflected in insurance rates. It may be that there are reasons why automatic sprinklers cannot be used in steamboats, but we can think of no difficulties not easily surmountable. We think it is the duty of those who operate such steamers as ply Long Island Sound to carefully investigate the question and to install sprinklers if possible. If they do not do it voluntarily then it would seem to be the duty of the authorities to enforce such installation and to ask for the necessary authority of law if they do not now possess it. Society has a right and it is its bounden duty to protect itself from such a wholesale murdering and torturing as is sure to take place sooner or later on one of these boats, unless something is done to prevent it. It ought not to be necessary for the public authorities to enforce such an obvious measure of safety but experience shows that it is necessary and it ought to be done immediately.

Government Report on Some Live Subjects.

The bulletin of the Bureau of Labor, No. 62, for January, issued by the Department of Commerce and Labor, Washington, is devoted to three subjects, all of which are of considerable interest to our readers. These are—Municipal Ownership in Great Britain, Conciliation in the Stove Industry, and Laws Relating to Child Labor.

The treatment of the first-named subject is by Frederick D. Howe, Ph.D., and at the beginning he makes a statement which will probably be a surprise to most people in this country. It is as follows: "In Great Britain municipal ownership is commonly known as municipal trading. Its critics call it municipal socialism. But it is not socialistic in intent, whatever its ultimate significance may be. The great extension of municipal activity that has taken place in recent years is not inspired by socialistic motives; at least, they are secondary. Municipal ownership was primarily promoted by the business men in control of the town councils, men who were not socialists by any means. In many cities socialists have a representation in the council, but they have not yet acquired sufficient power to direct public opinion, although they are always to be found on the side of any movement for a furtherance of municipal ownership. In its beginning municipal ownership was not socialistic; it was not even an outgrowth of the labor movement; it came rather from the mercantile or commercial classes."

Mr. Howe goes on to state the arguments pro and con, and to give conclusions drawn from them, and those who wish to be intelligent regarding this subject can scarcely do better than to apply to their representative in Congress or otherwise procure a copy of the bulletin referred to.

Much the same may be said regarding the second subject, which is treated by John P. Frey and John R. Commons. It treats a subject which we have often referred to, namely: the result of the work of the Stove Founders' National Defence Association, which, organized to fight the molders' unions, finally came into more or less co-operation with them, looking toward the preservation of peace and the establishing of permanent prosperity in the stove industry.

New Publications.

"Bookkeeping by Machinery," by E. W. Thompson. 167 6x9-inch pages with 67 illustrations. Published by the Author, 24 Broad street, N. Y. Price $2.

Probably no feature of industrial or commercial enterprises is undergoing more rapid transformation at the present time than bookkeeping. The introduction of the card index and loose-leaf-book systems has had wide influence and the application of mechanical aids is just beginning to be appreciated. Under these circumstances, this book by Mr. Thompson is extremely timely. It describes the various machines which are applicable to a bookkeeper's work, but it does much more than this, as, being himself an expert accountant, the author is able to describe the machines as parts of an accounting system. The reader is not left with a mere description of the machines, to find applications for them himself, but is shown how they are used to advantage in the matter of economy of time and increased clearness and simplicity of results. The book should be in the hands of every bookkeeper and cost accountant.

"Steam Turbines." By Wilhelm Gentsch. Translated from the German by Arthur R. Liddell. 335 7x10-inch pages, with 637 text cuts and 19 plates. Longmans, Green & Co., London, New York and Bombay. Price, $6.

The time for a comprehensive treatise on the steam turbine has undoubtedly arrived and in this effort to fill it we have a thoroughly characteristic illustration of German thoroughness. Almost every problem and phase of turbine construction are discussed in a strictly scientific, although surprisingly non-mathematical, manner. The book can be confidently recommended to all who are interested in the design, construction or use of turbines.

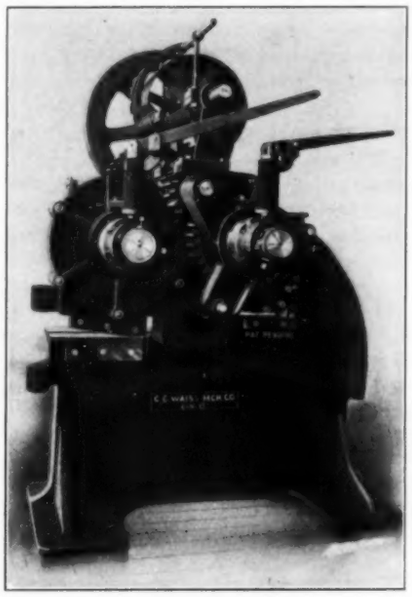
A new technical journal called *The Commercial Vehicle* has made its appearance. Though its name indicates a somewhat broader field perhaps, it is devoted to automobiles, such as are used in commercial service. It is a thoroughly up-to-date publication and seems well calculated to be of great value to all who are interested in such vehicles, either as users or builders. It is published by the Commercial Vehicle Company, Flatiron building, New York; its business affairs being under the direction of the experienced publisher, H. M. Swetland, while the editor is H. F. Donaldson. We are pleased to note that the new journal is standard size, 9x12 inches.

According to a recent rule of the Chicago & Alton Railway its surgeons, when making physical examinations of applicants for positions, reject those who are habitual cigarette smokers.

New Tools and Machine Shop Appliances.

A UNIVERSAL SHEAR.

The illustration shows a universal shear for cutting plates, bars and angles with even or uneven sides. In the front is the plate-splitting shear, the square opening on the side is the angle shear. Both shears are driven from one pulley and can be operated singly or both at one time. The clutch stops at the highest point only. The clutch lever is universal and can be turned to any side to suit the operator. Bars can be cut on either shear, and an extra shear for channels can be inserted on either side, or the machine may be adapted for punching.

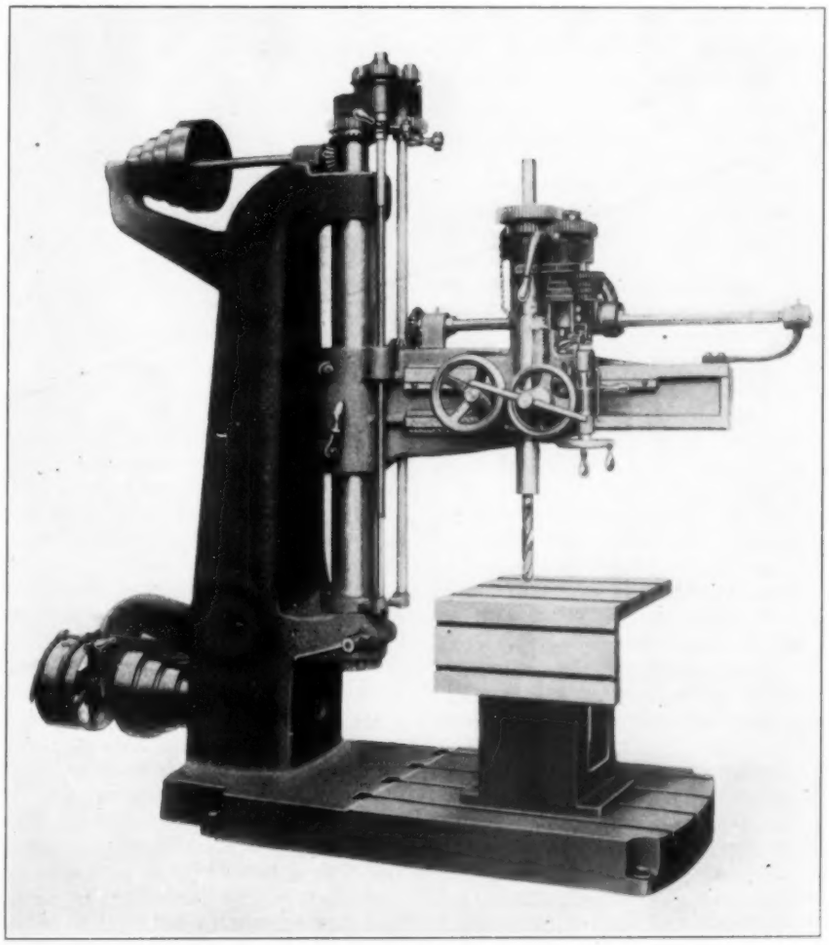


A UNIVERSAL SHEAR.

Weight of the machine, 6000 lb.; floor space, 4 ft. 10 in. x 4 ft.; hight, 7 ft. 4 in. This machine will cut ⅜-inch or trim ½-inch plate; with it 4x3½-inch or 5x3x⅜-inch angles may be cut. A larger machine is in course of construction. It is built by the C. C. Wais Machine Company, Cincinnati, Ohio.

A PLAIN RADIAL DRILLER.

The accompanying illustration shows a radial drill in which the base and main housing are cast in one piece. The housing has bearings at the top and bottom to receive the column. The lower bearing for the column is split and forms a clamping device for the column. The arm is elevated and lowered by power, and locked to the column by attached



A PLAIN RADIAL DRILLER.

handles. It is of box-girder cross section with closely spaced ribs inside. The head contains high- and low-speed gears operated by the lever seen at the top, quick return to the spindle, graduated automatic stop, tapping attachment, safety trip, and is provided with four changes of geared feeds arranged in geometrical progression from 0.006 to 0.021 per revolution of the spindle. These changes of feeds are instantly obtainable by sliding a pull-pin. The tapping attachment is located back of the head, and is operated by the handle behind the spindle. After reversing the spindle for backing out taps a high-speed return may be obtained through the back gear which can be engaged or disengaged without injury while the machine is in motion. A safety trip is provided to prevent the breaking of the feed gears in case the spindle is allowed to feed to its farthest limit. These machines are regularly supplied with the plain box table as shown, and a four-step cone-pulley drive and shifter mechanism shown. All handles are attached to the machine, and no loose wrenches are required. These machines are also supplied with swinging or universal tables and geared speed boxes. They are built by the John B. Morris Foundry Company, Cincinnati, Ohio.

Report on the Government Fuel Investigations—Formation of a "National Advisory Board."

The final report covering the investigations during 1904 at the Fuel Testing Plant at St. Louis, Mo., under the U. S. Geological Survey, has been published by the Government and is now ready for distribution. The report will appear in three volumes as Professional Paper No. 48, and will be distributed free of charge. Persons desiring copies of the report should apply for the same to a Member of Congress from their district, or to a Senator from their State.

The Government has been asked to appropriate $250,000 for the removal of the fuel-testing plant from the Exposition grounds in St. Louis, and the investigation of the coals, lignites, and other fuel substances of the United States, in order to determine their fuel values, etc., under the supervision of the director of the United States Geological Survey.

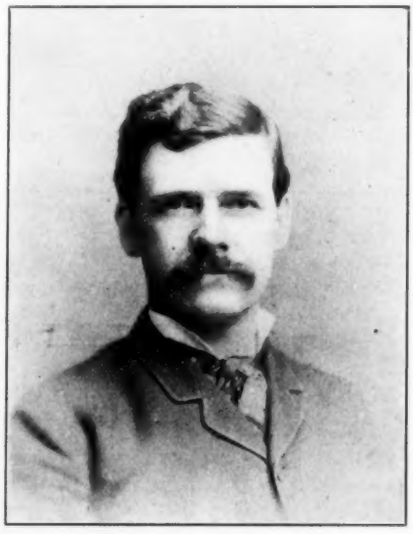
It is moreover desired to continue the work of investigating structural materials, which was also carried on to some extent during the Exposition, principally in cement mortars and concretes, as a result of a comparatively small amount appropriated by Congress. For this latter purpose the director of the Geological Survey has asked an appropriation of $100,000.

It is proposed to have all this work, as well as the investigations regarding the strength of timbers and methods of timber preservation which the Bureau of Forestry has been conducting, done subject to the advice of a board entitled "The National Advisory Board of Fuels and Structural Material," which has already been created, being constituted of members from each of the national engineering societies, the Institute of Architects, the Army and the Navy, railroad engineering and mechanical associations, and other interested organizations.

Thomas Richard Almond.

Last week we briefly announced the death of Thos. R. Almond, which occurred at his home in Dunwoodie Hights, Yonkers, on March 31, 1906, following a six days' illness from pneumonia.

Mr. Almond was born in Uppingham, Rocklandshire, England, in 1846. He came of Norman stock, his ancestors having settled near his birthplace as far back as the Conquest. He early displayed remarkable inventive mechanical ability and



THOMAS R. ALMOND.

at the age of 12 was awarded a special prize at a London exhibition for a model working steam engine involving an original and meritorions valve gear. He came to America in 1866, establishing himself as a machinist in Fitchburg, Mass., where he later married Eleanor Hortense Tollman. The business was removed to Brooklyn in 1875 and has since grown to large proportions developing engineering specialties under the Almond patents.

Mr. Almond was a versatile inventor, his numerous patents covering many fields; those which have been commercially successful including the Almond chuck, the Almond portable stove lamp, the Almond angular shaft coupling, the Almond turret head tool, and the Almond flexible metallic tubing. Two years ago, having relinquished control of his business, Mr. Almond then devoted his time to the development and perfection of a highly original and simple reaction steam engine which was nearly perfected at the time of his death. He was honored in being twice the recipient of the John Scott Medal awarded by the Franklin Institute of Philadelphia for meritorious invention.

Mr. Almond is survived by his widow, his father in England, a brother and a sister.

His interests were varied and he was a member of the Canadian Club, the Scarsdale Country Club, the Dunwoodie Country Club, an enthusiastic officer of the Yonkers Choral Union, a member of the American Association for the Advancement of Science, and a life member of the American Society of Mechanical Engineers, in which he took an active interest and whose transactions have been enriched by his papers and discussions. He was much interested also in horticultural studies and his home place is one of rare beauty as a result of his skill and knowledge of plants and shrubs. Kind and hospitable at home, upright in business, just to his workmen, loyal to his friends, a progressive character and a factor for good in the community in which he lived, he held the respect of all with whom he came in contact. The photograph from which our engraving was made was taken several years ago, but is as he was best known to many of his friends.

The Delivery of Coal by means of the Chicago Freight Subway.

The arrangements for delivering coal to buildings by means of the Chicago freight subway, which are approaching completion, seem to offer an ideal solution of this phase of transportation in cities. Branches of the subway tunnels run under the railroad yards, being about 40 or 50 feet below the ground level, and immediately above the tunnels are great concrete hoppers spanned by the tracks of the steam railroad, so that the railroad cars can drop their loads directly into the hoppers, which have chutes at the bottom to discharge into the little six-ton coal cars of the subway. From three to eight of these cars are hauled by an electric locomotive. The standard tunnel section is 6 feet wide, 7 feet 6 inches high in the center; they are 42 feet below the street level, and form a network below the business portion of the city. The subway coal cars are of the side-dump type and discharge into the hoppers of conveying apparatus, which takes the coal up into the basements of the large buildings. Those of us who daily have to buck the line of drays and trucks on the congested streets of a large city will wish for the speedy arrival of the day when it shall be usual to have all this traffic carried on in an orderly manner down in the ground, out of sight and hearing.

The Metric Situation.

A short time ago we mentioned a report made by the British Standards Committee in which mention we, through a misunderstanding, omitted to state that the committee named was appealed to by friends of the metric system in Great Britain to include in their recommendations of standard sizes, things to be made to metric dimensions. This, after careful consideration, the committee declined to do and all its recommended sizes are stated in English dimensions, though of course its recommended standards pertaining to electrical work are perforce based upon metric units. Though the committee's action with regard to metric dimensions of "shapes" and other things used in engineering construction is negative in character, it is nevertheless significant as indicating something of the obstacles to be overcome in Great Britain before the metric system can be generally introduced there.

In the meantime we have a communication from the Decimal Association saying that the prospects of favorable legislation by the newly elected Liberal Parliament are good, and another from the British Weights and Measures Association saying that there is no more chance of the metric system being adopted there than there is for ye editor becoming King of England. And as the editor is not even a candidate for the job, it will be seen that the chances are quite remote.

While among technical societies and organizations of manufacturers relatively little has been going on with regard to the matter, in other fields there has been much activity during the winter.

THE PENDING BILL.

About the beginning of the present session of Congress, Representative L. N. Littauer, of New York, who is a glove manufacturer, introduced a bill, the language of which is somewhat simplified as compared with former bills and provides simply that the various departments of the U. S. Government shall use the metric system after July 1, 1908.

The bill reads as follows: "Be it enacted, etc., That from and after July 1, 1908, all of the departments of the Government of the United States in the transaction of business requiring the use of weights and measures shall employ and use the weights and measures of the metric system."

No exceptions are made and there is nothing in it about "the standard." Those who favor the bill declare that it will not and is not intended to have any effect upon manufacturers generally except as a concrete example of the workings of the system in actual use, while it will much simplify the work of the various bureaus of the Government which, owing to their relations with foreign Governments and with the work and literature of scientists, are now compelled to use it in part. Those who oppose the bill declare that it is designed to be the entering wedge for the eventual displacement of our present weights and measures and for compelling our manufacturers to discard all their present expensive machinery and tools and re-equip with metric-built machinery and tools. Members of National Association of Manufacturers have, been active in opposition to the bill on the ground stated above, regarding which objection Mr. Littauer says that it is a bugaboo fashioned by a few men and that he doubts its representing the intelligent opinion of the association. Incidentally, he says he has himself withdrawn from the association, not liking the way its affairs are run. And so "you pays your money (or don't pay it) and you takes your choice."

THE HERALD'S CAMPAIGN.

By far the most active propaganda work that has been done so far has been carried on all winter by the *New York Herald* in favor of the system. We are not informed just how or why that paper has engaged in the fight, but probably it would not be far wrong to say that the American Board of Trade of Paris, which strongly favors the adoption of the metric system here, has influenced the proprietor of the *Herald*, Mr. Bennett, to take it up, Mr. B. having lived in Paris for some years, where a daily edition of his paper is also published.

The *Herald's* fight for the system is vigorously pushed, but in typical newspaper fashion — i. e., it confines itself strictly to the publication of such interviews, facts, opinions, etc., as are favorable to the metric system and rigidly excludes everything else.

Very little of what it has brought out is of special interest to machine constructors; but it published an interview with Herr Rathenan, chief director of the Allgemeine Electricitäts Gesellschaft of Berlin, whose establishment has close connections with the General Electric Company here, and who expressed himself as strongly hoping the metric system would be adopted here. Herr Rathenan, while recognizing the difficulty of introducing the system, and saying that there were difficulties with it in Germany which have even yet not been entirely overcome, nevertheless said:

"I may boldly assert, however, that there is not a single person in Germany who would not regard the return to the old system as a symptom of barbaric retrogression. Universally the old system is looked on here as a relic of primeval institutions, and how the Americans, whose spirit of enterprise we so much admire here, can still cling to such a fossilized method of measuring and weighing passes our comprehension, unless it be their desire to erect a barrier between themselves and the rest of the world, in order to retain the manufacture of their country's requirements in their own hands. . . . .

"The metric system may not be the best possible system that can be devised, but it is infinitely better than your system. We can turn out our work with greater accuracy working to millimeters, or the tenth part of millimeters, than you can with your fractions of inches, and it is easier to calculate with.

"There is not a single person of any standing in Germany who has his doubts on the subject, and if America desires to maintain the position she has secured for herself in the ranks of industrial and commercial nations, it is my decided belief that she must adopt the metric system without any further delay, or she will find herself isolated and left behind."

Herr J. Loewe, who is at the head of the Ludwig Loewe Company, and who has very many friends and acquaintances among manufacturers here, was also interviewed. He did not underestimate the difficulty of making the change and said, speaking of Germany's experience: "The transition stage occurred—a stage which is always disagreeable to every one concerned, but no different from what we experience every day that we remove from one house to another. . . . .

"Trade and industry in Germany accustomed themselves far more rapidly to the new state of things than agriculture. At the markets principally used by farmers even today the old system can be found in vogue. . . . .

"If the time saved in calculating by means of the metric system in Germany were expressed in money it would amount in the course of the year to many millions of marks, for it can be asserted that calculations can be made three times more rapidly by the aid of the decimal system than with the duodecimal [irregular] system.

"The construction of calculating machines will also be considerably facilitated by the adoption of the decimal system, and the new metric measurements introduced into Germany have proved to be excellent, and I can imagine no greater national calamity than the abandonment of the metric system.

"As a manufacturer I can welcome the introduction of the metric system into America. It would undoubtedly increase the import of American machines into this country, which would be tantamount to a keener competition. As, however, we also retail American machines, the adoption of the system would be of considerable advantage, as thereby a number of small drawbacks which render trade more difficult would disappear.

"But even from my standpoint as a manufacturer the introduction of the metric system into America would be advantageous, as I export to England, and in spite of the strong conservatism which is a feature of the country, there is no doubt that Great Britain would be compelled to adopt the metric system if the United States led the way."

Sir Guilford Molesworth, author of "Molesworth's Engineer's Pocket Book" expressed himself as strongly in favor of the metric system with which he had had experience, especially in connection with the Indian State railways.

Here in America the most noteworthy interview secured by the *Herald,* from the engineer's point of view is one from Charles H. Haswell, the venerable author of "Haswell's Engineer's Pocket Book," who is now about 96 years old and was a year ago elected an honorary member of the American Society of Mechanical Engineers. Mr. Haswell is consulting engineer to the Board of Estimate of New York City, and expressed himself as ready at any time to do his work to the metric system, he having had experience with it in his younger days and being familiar with it. He cited the interesting fact that, while chief engineer of the U. S. Navy he, in 1849, constructed the engines of the steam frigate "San Jacinto" to the metric scale. The arguments presented by the venerable engineer in favor of the metric system we do not repeat for, though interesting because coming from a practical engineer nearly 97 years old, they are not new, but have been presented by many advocates.

Perhaps largely as a result of the *Herald's* campaign, the Board of Aldermen of the City of New York, ordered January 16 by unanimous vote, the purchase of a set of metric standards for the city, and both branches of the Legislature of the State of New Jersey passed resolutions February 14 endorsing the Littauer Bill and urging its passage by Congress. As a result of this agitation there are those who profess their belief that the pending bill will pass, while there are others who seem very confident that it cannot pass.

IN CANADA.

In Canada, too, some effort is being made looking toward the adoption of the system and regarding this, Consul Seyfert, of Stratford, writes:

"With a view of adopting the metric system in weights and measures at an early day the Canadian Government is preparing and educating the people for change. Prof. J. C. McLennan, of the University of Toronto, has been engaged by the Dominion Government to devote the next year to explaining the system in a series of lectures in all the leading cities from Halifax to Vancouver. The professor delivered his first lecture on the subject at Stratford, February 7, before the board of trade. According to his explanation it is the object of the Canadian Government to secure a uniform standard of weights and measures throughout the entire British Empire, and thus to advance trade relations among the different colonies of the Empire. The board of trade at Stratford unanimously adopted resolutions, urging adoption of the system.

ENDOWMENT OF AN ANTI-METRIC BOOK.

Some time last fall a movement was started among machinery manufacturers to present to Messrs, Halsey and Dale a token of appreciation of their efforts in defense of the English system. At their suggestion, however, the money subscribed for the purpose was used as a campaign fund for the anti-metric cause. The copyright, plates and stock of printed copies of "The Metric Fallacy" were purchased from the publisher and the book was endowed, and a copy sent to each member of Congress with a slip attached to the title page bearing the following inscription:

*To Senators and Representatives in Congress*s "This book has been endowed with funds collected by voluntary subscription among American Manufacturers in order that a copy of it may be presented to all members of the Senate and House of Representatives.

"This is not only an endorsement of the work of Messrs. Halsey and Dale in making the first known collection of facts regarding the actual use of the metric system, but an earnest of the unwavering opposition of the manufacturers of this country to legislation for the adoption of that system.

"An examination of its pages will show how widely the facts in the case differ from the assumption on which the metric case is based."

COMPLIMENTARY DINNER TO MESSRS. HALSEY AND DALE.

The committee in charge of the raising of the fund, consisting of J. H. Schwacke, of William Sellers & Co., chairman; H. N. Covell, of the Lidgerwood Manufacturing Company; Thos. E. Durban, of the Erie City Iron works; Wm. Lodge, of the Lodge & Shipley Machine Tool Company; and Henry Sharpe, of the Brown & Sharpe Manufacturing Company, feeling that some further acknowledgment was appropriate, gave a complimentary dinner to Messrs. Halsey and Dale at the Waldorf Astoria, this city, the evening of March 31, Mr. Schwacke presiding and the other members of the committee being present except Messrs. Durban and Sharpe. Others present as guests of the committee, besides those representing various technical journals were: Geo. M. Bond; L. D. Burlingame, of the Brown & Sharpe Manufacturing Company; Marshall Cushing, Secretary National Association of Manufacturers; Geo. Moores, Secretary British Weights and Measures Association; Francis H. Stillman, of the Watson-Stillman Company; and W. A. Viall, of the Brown & Sharpe Manufacturing Company.

Following the dinner Messrs. Halsey and Dale were each presented with a cathedral-chime hall clock bearing the inscription, "The Man and The Hour."

THE SITUATION IN ENGLAND.

Among the after-dinner speakers was Mr. Moores, who outlined the situation in England, giving especially, particulars of the growing strength of his association. He also stated that the new British Prime Minister was recently asked if the Government would introduce a bill for the adoption of the metric system, to which he replied "no." He was then asked if he would permit such a bill to be introduced and discussed without the opposition of the Government, to which he again replied "no." Inasmuch as, under Parliamentary procedure, no bill can be passed to which the Government is opposed, Mr. Moores considers that this action disposes of any possibility of the passage of a metric bill during the lifetime of the present Parliament.

Mr. Moores also announced that the firm of Willans & Robinson, of Rugby, England, who have been so often referred to as an example of the successful use of the metric system, had given him a written statement that hereafter their new work will be based upon the inch and not, as for several years past, upon the millimeter. In this connection it is proper to explain that Capt. Sankey, who always maintained that the system was successful there, is no longer with the firm.

Mr. Moores referred also to the action of the Engineering Standards Committee mentioned at the beginning of this article and said that, considering the manner in which this committee is made up to represent all branches of engineering and many branches of industry, he regarded its action as most significant.

We may remark that there is, however, considerable difference between the attitude of the British Weights and Measures Association and our own opponents of the metric system. Not a few members of the association named are using the metric system, prefer it to the present English heterogeneity and steadfastly refuse to join in the sweeping denunciations of the meter and of metric advocates. Some of these favor the decimalization of the present standards, and for acknowledging the shortcomings of the present system have been sharply rebuked by our own doughty champions of the inch, foot, pound and ton, who insist that the present system is all that could be desired and can not be improved upon.

On the 4th of April Senator Beveridge introduced into the Senate a bill of the same import as that under consideration by the House committee, saying that he strongly favored such a start being made by the Government but was "not in favor of any attempt to force the metric system upon the business of the country in a way that would prove revolutionary."

On April 4 and 5 hearings were held by the House Committee on Coinage, Weights and Measures, which hearings took the form of a general round-up in which appeared a number of men rep-

resenting both sides, and in the two days 4 hours were allowed each side.

A COMMISSION PROPOSED.

Henry R. Towne, of New York, who appeared in opposition to the bill on the assumption that it would entail a great deal of expense for manufacturers, proposed that the committee recommend a bill providing that the President should appoint a commission composed of representative business men, scientists, educators and engineers, who should examine and report upon the whole question.

This it is understood completes the hearings, though ten days time (until the 17th of April) is given for the filing of statements by any who wish to do so and have not appeared before the committee.

Though there has been and is in connection with this discussion a good deal of personal bitterness and misunderstanding, as there always will be when opinions run counter to pecuniary interests, or are made to appear to do so, the question seems likely to be finally decided upon its merits, for there is no politics in it, and so far as we have heard, no advocate of the pending bill has been charged with being influenced by any ulterior motive.

In the meantime we shall endeavor to give the news of the movement, so far as it interests our readers, and will be glad, as we have previously announced, to print in our columns. not mere opinions pro or con, but records of experience and the preferences of those who have had actual experience with both systems in machine construction, which, of course, includes work over the drawing board as well as in the machine shop; and it will make no difference whether our contributors favor or oppose the metric system so long as they have had the required experience, will state what that experience is and will allow the use of their names; nor do we care what country the communications come from.

The Grand Trunk Railway of Canada has for some time had in operation an apprenticeship system, through which men are trained to fill the various positions on the line. The road has now supplemented this system by offering to the apprentices and other workmen, provided they be less than 21 years of age, two scholarships in the School of Applied Science of McGill University. The scholarships are to be awarded to the employees most successful in competitive examinations.—*The Engineer.*

The single-phase vs. continuous-current electrical traction controversy, to which we referred at page 98, is also being carried on in England, the adherents of the two systems being squarely opposed to each other, and the matter is in a state of much uncertainty, with the result of delaying the electrification of some of the railway lines.

Making Cast-Iron Frames for Electrical Instruments.

BY GEORGE BUCHANAN.

Fig. 1 is a view of a frame used on a line of metal boxes for motor starters, switches, fuses, etc. Two frames are required for each box; one for the back and the other for the front. Sheet metal is used to form the sides and ends, the sheet metal fitting outside the ledge *A* of the section, Fig. 1.

The former method used to make a frame was to prepare a wood pattern, or, it a metal frame having either the length or width required was at hand, to saw it up and patch together with strips of metal and fasten with screws, these strips having to be stopped off in the mold.

As orders come daily for ones and twos and seldom for dozens, the method was rather slow and frame patterns accumulated at a rapid rate. To overcome this and also to obtain the frames quickly the following device was found successful.

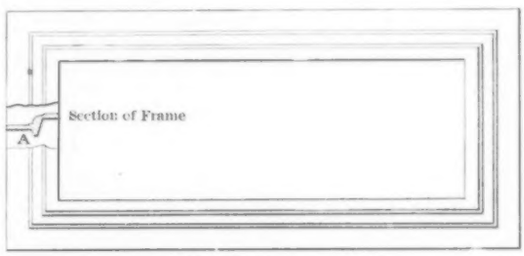


FIG. 1 The Piece to be Made

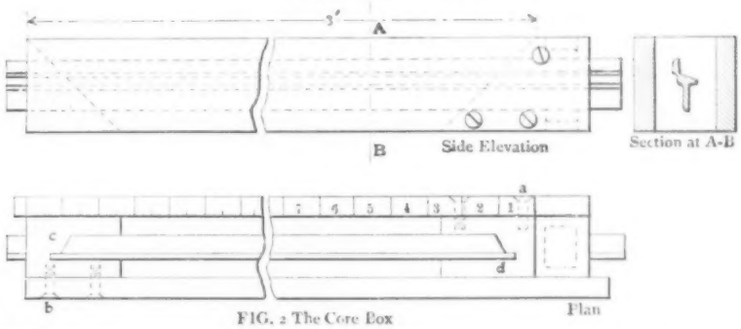


FIG. 2 The Core Box

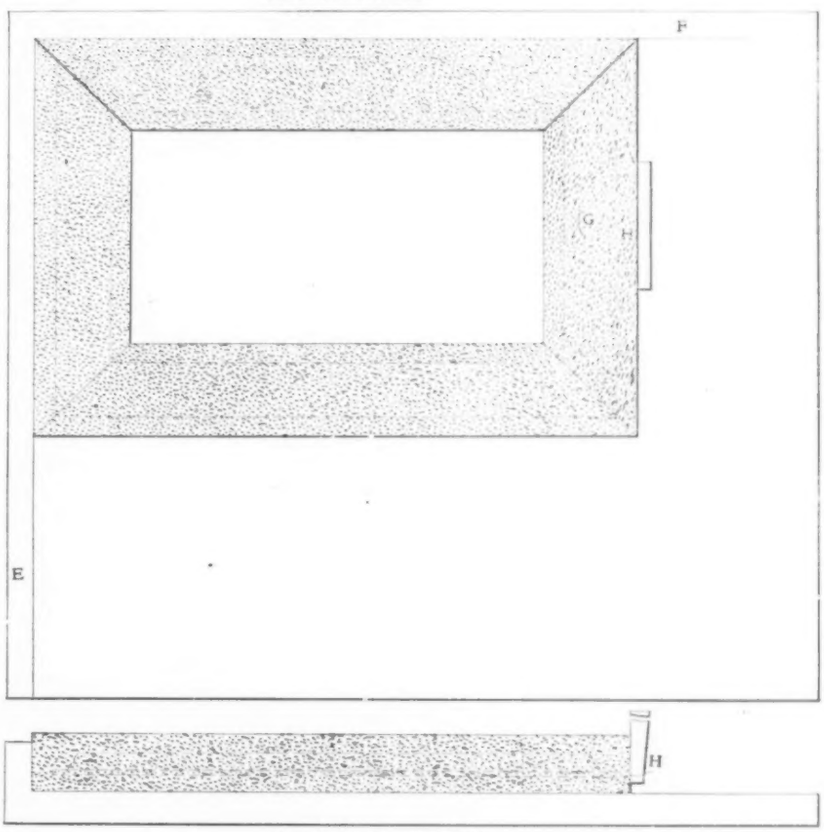


FIG. 3 The Complete Mold

Fig. 2 shows views of a metal core box having a strip of the molding which forms the frame fixed in the center of the box and held in its position at the ends by babbitted openings through which the strip of molding works freely.

The ends of the core box are mitered to give the required angular joint and are secured, each to one side of the box, by screws *a b* the joints *c d* permitting the parts to be adjusted for any length desired, the length being determined by the graduations shown which were laid out by a contraction rule and the parts being secured by clamps. A special mixture of sand is used giving a very clean sharp casting. To make a frame the size required is fixed on the core box, by sliding together or extending the box and then clamping the parts together and ramming up the core, after which the molding is struck at each end a few times and drawn out through the end of the box. The core being then placed on a level plate and the clamps removed the box is lifted away.

The four cores are then dried and placed on a plate, Fig. 3, which has two flanges *E F* cast on it. The cores are laid carefully against the flanges as shown and the core *G* is provided with an opening *H* (this being seen to when the cores are rammed up) which serves as a gate to pour the mold by. A few weights are placed around the outside of the cores and the runner made up which completes the molding. The pieces are straight, which is a very important feature in frame castings, and by using this method we are able to get frames of different sizes the same day that they are ordered, and that too without having to prepare patterns.

Wrexham, Wales.

Personal.

The editor would like to receive the present address of Henry Rebel, who, a few years ago, was a tool-maker in Brooklyn, N. Y.

Herbert V. Purman, who was until recently foreman of the tool room of the Reece Buttonhole Machine Company, has become assistant superintendent of the National Manufacturing Company, of Worcester, Mass.

Chas. Wainwright has become superintendent of the works of the Bury Compressor Company, of Erie, Pa. Mr. Wainwright was formerly connected with the Ingersoll-Sergeant Drill Company, of Easton, Penn., and has for the past three years been superintendent of the Blaisdell Machinery Company, of Bradford, Penn.

Obituary.

Frank Chandler, of the firm of Chandler & Farquhar, died at his home in Waverly, Mass., April 4, of pneumonia.

Amos L. See, who retired from the hardware manufacturing business three years ago, died at his home in Bleecker street, New York City, March 13, aged 69 years.

Oakes Tirrill, inventor and manufacturer of the Tirrill gas generating machine, died March 11 at his home in Brooklyn, N. Y., aged 86 years. Mr. Tirrill was born in Abington, Mass. He came to New York 45 years ago.

George F. Motter, Sr., of the firm of George F. Motter & Sons, engine and boiler makers, York, Penn., died suddenly at that place March 16, aged 67 years. Mr. Motter had been engaged in the manufacturing business for nearly fifty years and was interested in a number of concerns besides the one bearing his name.

James C. Beach, connected with the Lappin Brake Shoe Company, and until March 1 treasurer of the Railway Steel Spring Company, of New York City, died of pneumonia at his home in Bloomfield, N. J., March 21, aged 79 years. Mr. Beach was at one time a manufacturer of cardboard; later he engaged in paper manufacture, and then bought the patents of the Allen Paper Car Wheel Company.

Charles Lucius Baldwin, for many years associated with the J. B. Sargent Company, hardware manufacturers, of New Haven, Conn., died at that place March 15, 83 years of age. Mr. Baldwin was born in Meriden, Conn., but went to New Britain to live when a young boy. With his father he engaged in manufacture on a small scale and later he became associated with J. B. Sargent and helped found the Sargent Company, which later developed into one of the largest establishments in Connecticut.

John Bertram, head of the manufacturing firm of John Bertram & Sons, Dundas, Canada., died suddenly at his home in that place, April 4, aged 76 years. Mr. Bertram was a native of Eddlestone, Peebleshire, Scotland. He learned the machinist trade at Galashiels and came to Canada about 1856. For eight years he was with the Gartshore Foundry Company in Dundas, and in 1865, with Robert McKechnie, he founded the present business for the manufacture of wood and iron working machinery. In 1886 Mr. Bertram took his sons, Henry and Alexander, into business with him, and Mr. McKechnie retired. The business has long been one of the best known in Canada.

Business Items.

The Pittsburg offices of the Niles-Bement-Pond Company have been removed to 713-714 Frick Building in that city.

The Challingsworth Foundry and Machine Company, Mt Vernon, Ohio, has just erected a large foundry which is equipped for handling the largest castings.

The Buffalo Forge Co. Buffalo, N. Y., has recently received orders for a "Buffalo Automatic"Engine to be used in connection with an electric lighting plant in Japan.

Schellenbach & Radcliffe, Cincinnati, Ohio, has been merged into the Schellenbach & Darling Tool Company. Of the new company, J. W. Darling is president and treasurer; L. B. Gilbert, secretary and C. O. Schellenbach vice-president and general manager.

The Hisey-Wolf Machine Company, Cincinnati, Ohio, has been advised by Alfred H. Schutte, its Brussels agent, that they have been awarded "Mention Honorable" and given a diploma on their portable Electrical Hand Drills and Tool-post Grinders, exhibited at the Liege, Belgium. Universal & International Exposition.

The Lumen Bearing Company, Buffalo, N. Y., has recently completed a large addition to its plant. The addition is a brick structure containing offices, machine shop, shipping department, storage and metal vaults, etc. Their addition affords a molding room 60 by 200 feet, which is equipped with Coburn track and crane.

A. E. Hoermann M. E., who has been representing the Curtis & Co. Mfg. Co., F. F. Slocomb & Co., and in the Dayton Pneumatic Tool Co., with offices at 261 Broadway, New York, has just removed his quarters to 41 Park Row. After the first of April he will represent the Pilling Engine Co., Detroit, Mich., in addition to the above concerns.

The Allis-Chalmers Company, of Milwaukee, Wis., is sending out an account with photographs, showing the methods of manufacturing railroad frogs as followed by the Weir Frog Company, at its shop in Norwood, Ohio, a suburb of Cincinnati. Large numbers of machine tools are used which are driven by motors made by the Allis-Chalmers Company.

The Omega Steel and Tool Company, 93 Main St., Ansonia, Conn., has been organized and has equipped a factory for manufacturing and selling Omega Steel, and will make lathe and planer tools, milling cutters, twist drills, slitting saws; reamers, dies and punches for press use, etc. The officers of the company are Charles Hudson, president and general manager; Dennis T. Walsh, secretary, and Wm. H. Conklin, treasurer.

Manufacturers.

The Hicks Gas Motor Company, Waycross, Ga., will add a foundry.

The Isbell-Porter Company, Newark, N. J., will enlarge its foundry.

The Pittsfield (Mass.) Electric Company will erect a new plant.

The Marion (Ind.) Malleable Iron Works, will double its capacity.

The Dexter Folder Company, Pearl River, N. Y. will build an addition.

The Carr Foundry Company, Baltimore, Md., will build an addition.

The Red Wing (Minn.) Boat Manufacturing Company will erect a new plant.

The Alabama Great Southern Railway will enlarge its Gadsden, Ala., car shops.

The National Car Coupler Company, Converse, Ind., will move to Attica, Ind.

The Pittsburg (Pa.) Gage & Supply Company has bought site for a new factory.

Binney & Godfrey, structural iron manufacturers, Brooklyn, N. Y., will build a new factory.

The Sheffield (Ala.) Steel Range & Stove Company has commenced the erection of a new plant.

The American Emery Wheel Works, Providence, R. I., will erect a three-story addition to its plant.

The Patterson-Sargent Company, Cleveland, Ohio, manufacturer of paints will erect a new factory.

The Mayhew Manufacturing Company, Milwaukee, Wis., furniture, will erect a new $15,000 factory.

The Toledo (Ohio) Metal Sign Company will erect a new plant to replace the one burned recently.

The Columbia (S. C.) Electric Street Railway Company is erecting a power house to cost about $30,000.

August Schubert, Elmira, N. Y., formerly of Schubert Bros. Gear Company, will erect a factory for the manufacture of wagons and carriages.

Allen K. Walton of Hummelstown, Pa., has purchased the Hummelstown water plant and the Hummelstown electric-light plant and will install new dynamos, etc.

The Westinghouse Electric and Mfg. Company of Pittsburg, is planning to erect a plant in Bloomfield, N. J., for the manufacture of incandescent lamps.

The Cannon Patent Manufacturing Company, Florence, Colo., has been organized to manufacture hay binder machinery and a patent door vise. Capital $100,000. W. E. Walters, president; Harry Cannon, vice-president.

The Western Railway & Development Company, has been incorporated at Chehalis, Wash., to build a railroad from that place to Aberdeen and South Bend. Francis Donahoe, ex-mayor of Chehalis, is one of the incorporators.

The Taylor Electric Truck Co., Troy, N. Y., is in the market for a second-hand size No. 1 double punch and shear, Long & Allstatter make, as per page 41 of their No 20 catalog, same to be in good order, and with about a 10-inch depth of throat.

The Pennsylvania Pneumatic Pump Company, Davenport, Iowa, is to be reorganized and move to Binghamton, N. Y., where a plant will be erected in the near future. E. E. Hyer, Binghamton Press Building, is connected with the company.

The Hyrum A. Silver Foundry and Machine Company is being incorporated at Salt Lake City, Utah, with a capital of $150,000. A plant comprising five buildings will be put up. Joseph J. Daynes, Jr., will be president, Hyrum A. Silver, vice-president and manager.

The Mississippi River Power Company, is being incorporated at St. Cloud, Minn., with a capital of $50,000. The company will build a dam and operate a pulp and paper mill near Clearwater. E. F. Moore, president of the First National Bank, St. Cloud, is one of the organizers.

The Perry-Fay Manufacturing Company is being formed at Elyria, Ohio, with a capital of $300,000. A factory will be erected for the manufacture of all kinds of brass, steel and iron screws, nuts, etc. Messrs. Perry and Fay are now with the Western Automobile Machine Screw Co., of Elyria.

The Burnham, Hitchins, Pierson Company, which is a merger of the Burnham Boiler Works of Tarrytown, N. Y., the Hitchins Iron Works, Jersey City and the Pierson Boiler Company, New York. will erect a large plant in Elizabeth, N. J., for the manufacture of complete equipment for greenhouses.

The E. F. Reece Company, Greenfield, Mass. Booklet describing the "Reece" screw plates in detail. The cover represents the outside of a screw plate box showing the graining of the wood, etc. The book also contains price lists and illustrations and will be sent to anyone interested on application to the firm. 3½x6, pp. 9, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Parallel attachments for drawing tables. F. G. Hobart, Beloit, Wis., Dealers or by mail.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Full particulars of an engine or motor, suitable for Aeronautical use. About 100 D.H.P. Box 420, AMERICAN MACHINIST.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford st., Philadelphia, Pa.

Work Wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Gray iron Foundry in New England desires to take up the manufacture of some specialty requiring high-grade castings, preferably castings having intricate cores and requiring minimum of machining. Box 344, AM. M.

Mechanical organizer—I will visit your factory, study your methods and product, and stop the leaks of time, tools and materials. Thirty years' experience. Let me consider your needs. C. E. Tower, 1237 Monadnock Bldg., Chicago.

Tool catalog No. 22, 950 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

Will pay for working drawings of hydraulic wheel press for general work, about 40" with 12' 6" centers, showing detailed working instructions of all parts and how to build it. Our finishing tools are limited to one 30" lathe and one 30" planer. L. B. L., 415 AMERICAN MACHINIST.

Engineer in Charge—To operate lighting plant. Location North Central States. 10,000 horse power plant including Compound Engines, Steam Turbines, Water Tube Boilers; complete equipment of A. C. and D. C. apparatus. Salary depends upon ability of the man to operate the plant economically. C. 5518. Engineering Agency, Inc., Chicago.

For Sale.

For sale—Foundry, Wood & Iron machine shops, Albion, N. Y. Box 74.

For Sale—Bound volumes AMERICAN MACHINIST, 1880-1900 inclusive. Splendid condition. Box 419, AMERICAN MACHINIST.

For Sale—One Shafer Hydraulic Platen Press, 60 ton pressure, 18" platen with a 12" movement of ram, complete with pump, belt drive, lock up pressure and safety valve." Box 406, AMERICAN MACHINIST.

For Sale—Gas engine business with engines from two to sixty horse-power capacity. Stock of finished and unfinished engines and patterns, drawings, etc. Will sell at a bargain. Apply Box 55, AMERICAN MACHINIST.

Business Opportunities.

Wanted—A growing machine tool shop desires capable mechanical man who can invest in same. Good, legitimate opportunity. Address Manager, 408 AMERICAN MACHINIST.

Capitalist promotor and salesman wanted to incorporate steam pump, pumping engine and air compressor. Manufacturing Company ready to start patents all over the world. Box 425, AMERICAN MACHINIST.

Wants.

Situation and help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Position as manager or superintendent of a plant building either gas engines, steam engines, pumps or heavy machine tools. I have held same position for ten years and am up-to-date in modern methods and shop system. G. V. Mitchell, Chicago Heights, Ill.

IOWA.

Chief draftsman; a mechanical engineer, at present chief draftsman with a large manufacturing concern in the west. Box 269, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—A position in a trade school, or in the mechanical department of some engineering school, or in some shop in charge of apprentices. Specialty machine design and construction. "Entropy," 392, AM. MACH.

MICHIGAN.

Wanted—Position as assistant superintendent by a technical graduate, age 30, with shop and drafting-room experience. Familiar with modern methods and a hustler. Box 422. AMERICAN MACHINIST.

Chief Engineer of 4000 horse power steam electric plant, cross-compound engines, mechanical stokers, etc., wants to change. Excellent references and satisfaction guaranteed. Box 423, AMERICAN MACHINIST.

NEW JERSEY.

A practical machinery or machinery specialties salesman; age 35; technical graduate; 12 years' experience traveling. Box 409, AMERICAN MACHINIST.

NEW YORK.

Superintendent, expert mechanic, thoroughly competent in every respect, desires change. Box 376, AMERICAN MACHINIST.

Designer on tools, jigs and fixtures, open for engagement; practical, up-to-date; 10 years' experience. Box 418, AMER. MACH.

Mechanical draftsman, graduate, several years' experience as draftsman and designer, open for engagement. Box 400 AMER. MACH.

General foreman (36), responsible man, practical mechanic, successful in producing first-class work at satisfactory cost, varied experience, desires change. Box 354, AM. M.

Designing draftsman, M. E., age 30, 2 years' shop, 9 years' office, on special machinery, tools, fixtures, devices. Inventive, practical good judgment, hustler. Box 414, AM. M.

Mechanical graduate, age 28, American (Westerner) experienced office, drafting and shop, good executive, desires a position where merit brings advancement. Box 424, AMERICAN MACHINIST.

Machine shop foreman or assistant superintendent. (Westerner), technical graduate and familiar with modern shop practice. Box 388 AMERICAN MACHINIST.

A practical machinist and draftsman with a number of years successful experience in handling help and who can give the very highest references as to his standing and ability, is open for engagement as manager or superintendent of machine works. Box 426, AMERICAN MACHINIST.

PENNSYLVANIA.

Machine Tool Draftsman, 6 years' experience, desires position on the road with reliable firm in a mechanical line. Box 416, AMERICAN MACHINIST.

Wanted—To correspond with a firm in the machine and foundry business employing 500 or more men, who desire a superintendent with ability, health and character. Box 384, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Tool room foreman; must be able to design tools, jigs and fixtures for light accurate work. References required. Box 389, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—A good, capable, energetic man to take charge of machine and manufacturing shop in Connecticut. Address Lake, 407 AMERICAN MACHINIST.

Coremaker foreman for large foundry in

New England. Good salary to man capable of handling 75 coremakers on high-grade work. Give full particulars as to age, experience, references, salary desired, and class of work most familiar with. Box 410, AM. M.

ILLINOIS.

Wanted—man of business experience and recognized standing as engine expert to take charge of gas engine development for large manufacturing company. Box 403, AM. M.

Wanted—General foreman for large shop making special machines. Only high-class, practical, experienced man of executive ability, who is holding similar position, will be considered. Requires man fully capable of handling 300 to 400 men. State if experienced in foundry work. Excellent opportunity. All communications held strictly confidential. Box 421, AMERICAN MACHINIST.

INDIANA.

Wanted—Manufacturing superintendent; light machine manufacturer, good experienced man only need apply. Address R, 310 AMERICAN MACHINIST.

IOWA.

Wanted—Three operators for automatic screw machines in a Western city. State experience and kind of machines familiar with. Box 332, AMERICAN MACHINIST.

MARYLAND.

Wanted—An establishment making specialty of a very fine line of Power Transmission machinery wants two travelling salesmen. State age, married or single, experience, references and salary expected. Address Transmission, 398 AMERICAN MACH.

MASSACHUSETTS.

Expert gear cutting man; also one young man for general office and shop assistant. Boston Gear Works, Boston, Mass.

Wanted—Two mechanical draftsmen. Men with some experience in structural steel work or steam boiler construction preferred. Location near Boston. Box 404, AM. MACH.

Wanted—A man who thoroughly understands operation of Gould & Eberhardt gear cutters. Must be familiar with cutters and know how to turn out the maximum product of high-grade work. Address "B" 362 AM. M.

Wanted—Foremen of experience on medium weight, accurate work, to take charge of planing and milling departments in up-to-date factory with modern equipment. Good positions for competent men. State age, experience, and wages desired. Box 367, AM. M.

MINNESOTA.

Expert all-around machinist on rotary printing press work. A. B. Hunkins, Austin, Minn.

NEW JERSEY.

Draftsmen— We have positions now open for draftsmen. Call or address Henry R. Worthington Harrison, N. J.

Wanted—First-class lathe and vise men for small steel work. Steady work, good pay, no trouble. Twenty-five miles from New York City. Box 194, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—By a firm near Newark, N. J., first-class mechanical draftsmen on electrical machinery, also a tool designer. None but experienced men wanted. State salary expected and how soon able to begin. Box 390, AM. M.

Wanted—A first-class hand on Pratt & Whitney automatic screw machines. A good place and steady work for the right man. Apply or send recommendations or references to Domestic Sewing Machine Co., Newark, N. J.

Wanted—Two or three thoroughly reliable and experienced draftsmen on tools and fixtures. This may prove a very unusual opportunity for the right man. Apply by letter only with copies of recommendations or names of references to Frederick M. Bush, Supt., 31 Halsey St., Newark, N. J.

NEW YORK.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Toolmakers wanted; men of experience on punch and die work. Address Central New York. Box 412, AMERICAN MACHINIST.

Wanted—Expert draftsmen; designers on a line of dies, jigs, fixtures and shop tools for light, interchangeable work. Factory outside New York. Box 377 AMERICAN MACHINIST.

Toolmakers—Wanted immediately, first-class toolmakers on high-grade dies, jigs, gauges and special fixtures for small machine manufacture. Send references to Drawer 7, Syracuse, N. Y.

Wanted—Mechanical draftsman with at least two or three years' experience at detail work. Attractive salaries to good men. State age and experience. Address Box 366, AMERICAN MACHINIST.

Wanted—A first-class mechanical draftsman in a large manufacturing concern in New York City. Must have a knowledge of printing presses. Address G. M. B., 411 AMERICAN MACHINIST.

Wanted—We have openings for a few electrical and mechanical draftsmen. State age, experience and salary expected. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Two machinists, especially experienced running large Ingersoll Milling Machine, to work in city twenty miles from New York. Give age, experience, reference and wages expected. Box 408, Yonkers, N. Y.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hour work day; time and a half for overtime double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

OHIO.

Wanted—first-class machine foreman accustomed to producing interchangeable parts to close limits from lathes, milling machines and drill presses; one capable of handling about 125 men. Box 405, AMERICAN MACH.

Wanted—Traveling salesman for southern territory by large manufacturer of small tools, located in Middle West. State age, and experience. Correspondence confidential. Address Box 393, AMERICAN MACHINIST.

Wanted—Mechanical engineer and draftsman. For designing machines (small and medium, jigs and fixtures for rapid production. Must have at least 10 years' experience. Steady employment; good salary. Give age, detailed experience and salary expected. Box 413, AMERICAN MACHINIST.

Wanted—First-class man to take charge of designing of up-to-date jigs and fixtures for machine-tool work. Must be capable of giving instructions in use of the same. None but parties having practical shop experience need apply. State experience and salary wanted. Address Cincinnati Milling Machine Co., Cincinnati, O.

PENNSYLVANIA.

Wanted—Experienced draftsman on circuit breaker work. Address The Switchboard Equipment Co., Bethlehem, Pa.

Die and toolmakers accustomed to medium power press stamping dies. Good wages for the right men. Box 417, AMERICAN MACH.

Wanted—Several first-class scrapers, also planer and lathe hands, for machine tool work. Address, Colburn Machine Tool Company, Franklin, Pa.

Wanted—By an automobile concern at present engaged in the manufacture of pleasure cars, a chief engineer, experinced in this line of work, to underake the design of commercial vehicles. Applicants must state age, experience, references and terms. Address Box 386, AMERICAN MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections, these qualifications carry most weight; character, common sense, experience with automatic machinery, (or) printing-office experience, or type foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA.

Wanted—Accurate machinist on Marine Engine work. Ward Engineering Works, Charleston, W. Va.

WISCONSIN.

As the result of doubling its new West Allis Plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Wanted—Experienced draftsman, one familiar with wood-working machinery preferred. Good opening with large and growing concern. Box 373, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Tool and jig workers and gas engine men; good wages if competent. Witte Iron Works Company, Kansas City, Mo.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	102
Acme Machinery Co.	34
Adams Co	9
Albro-Clem Elevator Co.	100
Alliance Machine Co.	108
Allington & Curtis Mfg. Co.	93
Almond Mfg. Co., T. R.	107
Alteneder & Sons, Theo.	34
American Gas Furnace Co.	14
American Pulley Co.	101
American Tool & Machine Co.	93
American Tool Works Co.	8
American Tube & Stamping Co.	101
Armstrong Bros. Tool Co.,	87 and 94
Auburn Ball Bearing Co.	90
Aurora Tool Works	90
Automatic Machine Co.	93
Baird Machinery Co.	87
Baker Brothers	28
Baldwin Chain & Mfg. Co.	95
Baldwin Steel Co.	99
Barker & Co., Wm.	95
Barnes Co., B. F.	22
Barnes & Son, T.	92
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E.	89
Bay State Stamping Co.	105
Bay State Tap and Die Co.	104
Beaman & Smith Co.	15 and 106
Becker-Brainard Milling Machine Co.	23
Bertram & Sons Co., John	28
Besly & Co., Chas. H.	99
Bethlehem Fdry. & Mach. Co.	94
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	88
Bilgram, Hugo	34
Billings & Spencer Co.	90
Binsse Mach. Co.	34
Birdsboro Steel Fdry. & Machine Co.	81
Blaisdell Machinery Co.	96
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Bliss Electrical School	28
Blount Co., J. G.	95
Boker & Co., Hermann	81
Boston Gear Works	104
Boynton & Plummer	91
Bowers, E. J.	96
Bradford Machine Tool Co.	5
Brickner Machine Co.	92
Bridgeport Safety Emery Wheel Co.	102
Bristol Co.	4th cover
Brown-Cochran Co.	92
Brown Hoisting Mach. Co.	109
Brown & Co., R. H.	106
Brown & Sharpe Mfg. Co	4th cover and 71
Buffalo Forge Co.	4th cover
Builders Iron Fdry.	3rd cover
Bullard Auto. Wrench Co.	91
Bullard Machine Tool Co.	32
Bury Compressor Co.	96
Butler, A. G.	96
Caldwell & Son Co., H. W.	105
Carborundum Co.	20
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	84
Case Mfg. Co.	108
C & C Electric Co.	29
Chambersburg Engr. Co.	89
Champion Tool Works	89
Chattanooga Machinery Co.	94
Chicago Rawhide Mfg. Co.	105
Chisholm & Moore Mfg. Co.	109
Cincinnati Electrical Tool Co.	28
Cincinnati Machine Tool Co.	20
Cincinnati Milling Mach. Co.,	6 and 7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	110
Clark Cast Steel Cement Co.	95
Clark, Jr. & Co., Jas.	106
Cleveland Automatic Mch. Co.	18
Cleveland Crane & Car Co.	108
Cleveland Twist Drill Co.,	4th cover and 1
Clough, R. M.	94
Coates Clipper Mfg. Co	89
Coes Wrench Co.	33
Colburn Machine Tool Co.	22
Columbus Machine Co.	92
Cook Co., Asa S.	91
Crescent Forgings Co.	97
Cresson Co., Geo. V.	107
Crocker-Wheeler Co.	29
Crosby Steam Gage & Valve Co.	17
Crowe Name Plate & Engraving Co.	84
Cumberland Steel Co.	91
Curtis & Co. Mfg. Co.	108
Curtis & Curtis Co.	103
Cushman Chuck Co.	106
Davis, Rodney	104
Davis Machine Co., W. P.	86
Desmond-Stephan Mfg. Co.	102
Detrick & Harvey Mach. Co.	85
Diamond Machine Co.	3rd cover
Diehl Mfg. Co.	28
Dill Machine Works, T. C.	28
Dixon Crucible Co., Joseph	93
Dodge & Day	84
D'Olier, Jr., Co., Henry	31

PAGE

Dreses Machine Tool Co..... 89
Durbrow & Hearne Mfg. Co.. 93
Dwight Slate Machine Co....102

Earle Gear & Mach. Co.....104
Eberhardt Bros. Machine Co..105
Eck Dynamo & Motor Works. 28
Elliott Chemical Works..... 91
Elmes Eng. Works, Chas F.. 96
Equipoise Rivet Co.....108
Errington, F. A. 107
Evans Friction Cone Co..... 94
Excelsior Needle Co. 89

Fairbanks Co 87
Farrel Fdry. & Mach. Co..... 84
Fawcus Mach. Co.....104
Fellows Gear Shaper Co.....104
Fenn-Sadler Machine Co.....103
Firth Sterling Steel Co.....101
Fitchburg Machine Works.... 31
Foos Gas Engine Co..... 92
Foote, Burt & Co..... 94
Fosdick Machine Tool Co.... 16
Franklin Mfg. Co., H. H..... 98
Frevert Machinery Co.....108

Gang Co., Wm. E.,..... 84
Gardner Engineering Co..... 91
Gardner Machine Co.....102
General Electric Co. 26
General Pneumatic Tool Co... 95
Geometric Tool Co..... 25
Gleason Works .....4th cover
Goldschmidt Thermit Co.....100
Goodell Pratt Co..... 88
Gorton Machine Co., Geo..... 90
Gould & Eberhardt 96
Graham Mfg. Co..... 92
Grant Gear Works 104
Gray Co., G. A..... 34
Gray & Prior Machine Co....107
Greaves, Klusman & Co..... 91
Greendale Gas Engine Co.... 92
Greenfield Steam Engine Works 108
Greenwald Co., I. & E.....104

Hammacher, Schlemmer & Co. 77
Hamelle, Henry 100
Hampden Corundum Wheel Co. 93
Harrington Son & Co., Edw... 98
Hartford Steam Boiler Insp. & Ins. Co. 92
Hendey Machine Co..... 79
Henley Publishing Co., N. W. 85
Henry & Wright Mfg. Co.... 93
Heppenstall Forge & Knife Co. 84
Hess-Bright Mfg. Co..... 90
Hill, Clarke & Co..... 87
Hisey-Wolf Machine Co..... 24
Hoefer Mfg. Co. 28
Horsburgh & Scott Co..4th cover
Horton & Son Co., E.....106
Hunt Co., C. W.....108
Hunt & Co., Robt. W.....100

PAGE

Hyatt Roller Bearing Co..... 91

Ingersoll Milling Machine Co. 88
Ingersoll-Rand Co. 97
International High-Speed Steel Co. 100
Iroquois Machine Co.....102

Jacobs Mfg. Co.....106
Jacobson Mach. Mfg. Co..... 92
Jantz & Leist Electric Co.... 28
Jeffrey Mfg. Co., The..... 86
Jenkins Brothers 93
Johnson Machine Co., Carlyle 31
Jones & Co., B. M.....100
Jones & Lamson Machine Co., 12, 13 and 34

Kelly, P. J. 24
Kent & Co., Edwin R.....100
Kilbourne & Jacobs Mfg. Co.103
King Machine Tool Co.....88

Landis Machine Co..... 85
Landis Tool Co 73
Lapointe Machine Tool Co... 84
LeBlond Machine Tool Co., R. K. .....4th cover
LeCount, Wm. G. 106
Link-Belt Engineering Co.... 83
Lodge & Shipley Machine Tool Co. 4
Long & Allstatter Co., The.. 94
Lunkenheimer Co., The..... 93
Lyon Metallic Mfg. Co..... 88

Main Belting Co..... 96
Maris Bros. 108
Marshall & Huschart Mch. Co. 87
Massachusetts Saw Works... 89
McCabe, J. J.....86 and 107
McGeorge Mfg. Co..... 91
McInnes Steel Co.....100
Merrell Mfg. Co..... 90
Merrill Bros. 92
Merritt & Co. 84
Mfg. Equipment & Eng. Co..103
Mietz, A. 92
Millers Falls Co.....103
Miner & Peck Mfg. Co.... 88
Modern Machinery Daily News 84
Moore Co., Franklin 108
Morris Foundry Co., John B. 15
Morse Chain Co 103
Morse Twist Drill & Machine Co. 33
Morse, Williams & Co.....105
Motch & Merryweather Mch. Co. 87
Mueller Machine Tool Co....107
Mutual Machine Co.....105

National Acme Mfg. 110
National Corundum Wheel Co.102
Nazel Engineering & Machine Works 84
New Britain Machine Co..... 93
New Era Gas Engine Co..... 92

PAGE

New Haven Mfg. Co..... 89
New Process Raw Hide Co...105
Newton Machine Tool Works. 11
Niagara Falls Brass Works.. 20
Nicholls, Wm. S.....109
Nicholson File Co..... 17
Nicholson & Co., W. H..... 92
Niles-Bement-Pond Company, 86, 111, 112, 113, 114
Northern Electrical Mfg. Co. 26
Northern Engineering Works.108
Norton Emery Wheel Co..... 83
Norton Grinding Co..... 30
Nuttall Co., R. D. 104
Nutter, Barnes & Co..... 85

Obermayer Co., S. 100
O. K. Tool Holder Co..... 87
Owen Machine Tool Co..... 22

Parker Co., Chas..... 92
Patterson, Gottfried & Hunter, Ltd. 110
Pawling & Harnischfeger....108
Paxson Co., J. W..... 88
Philadelphia Bourse 91
Philadelphia Gear Works.... 104
Phillips-Laffitte Co. 100
Poole Co., J. Morton..... 94
Potter & Johnston Mach. Co.. 79
Pratt Chuck Co.....106
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co... 86
Prentiss Vise Co..... 92

Queen & Co., Inc 24

Ransom Mfg. Co..... 77
Reed Mfg. Co. 92
Reeves Pulley Co..... 25
Reichheim & Co., E. P., 4th cover
Rivett Dock Co.....3rd cover
Rivett Lathe Mfg. Co..3rd cover
Rockford Machine Tool Co... 90
Rockwood Mfg. Co.....109
Rodgers Machine Tool Works, Geo. C. 24
Rogers Works, John M..... 89
Rowbottom Machine Co.....103

Safety Emery Whel Co.....102
Sames, C. M. 85
Saunders Sons, D. 90
Sawyer Gear Works.....104
Schieren & Co., Chas. A..... 96
Schumacher & Boye 9
Schwerdtle Stamp Co..... 90
Scranton & Co.....100
Sebastian Lathe Co..... 85
Sellers & Co., Wm 21
Seneca Falls Mfg. Co..... 24
Shaw & Co. 96
Shelby Steel Tube Co..... 91
Shultz Belting Co..... 85
Sibley Machine Tool Co..... 88
Simonds Mfg. Co.....103
Skinner Chuck Co.....106
Sloan & Chace Mfg. Co..... 34
Slocomb Co., J. T..... 85
Smith & Mills 87

PAGE

Speed Changing Pulley Co...105
Spicer Universal Joint Mfg. Co. 106
Sprague Electric Co..... 27
Springfield Machine Tool Co... 99
Standard Engineering Works. 90
Standard Gauge Steel Co.... 94
Standard Machinery Co..... 90
Standard Tool Co..... 95
Stanley G. I. Elec. Mfg. Co... 98
Stark Tool Co. 90
Starrett Co., L. S..... 16
Steptoe Shaper Co., John.... 94
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Three Rivers Tool Co.....100
Tindel-Morris Co..... 75
Toomey, Frank 88
Triumph Electric Co..... 28
Trump Bros. Machine Co.....106
Turner Brass Works..... 84

Underwood & Co., H. B..... 14
Union Twist Drill Co..... 75
United Eng. & Foundry Co... 98
U. S. Watch Tool Co..... 94

VanDorn & Dutton Co.....104
Vandyck Churchill Co..... 30
Veeder Mfg. Co..... 93
Vitrified Wheel Co.....102

Wallace Supply Co..... 96
Waltham Machine Works....109
Ward & Sons, Edgar T., 33 and 100
Warner Instrument Co.....107
Warner & Swasey Co..... 73
Waterbury Farrel Foundry & Mach. Co. 91
Watson-Stillman Co..... 24
Webster & Perks Tool Co....102
West Haven Mfg. Co...4th cover
Westinghouse Elec. & Mfg. Co. 29
Westmacott Co., J. M.....106
Wickes Bros 86
Whitcomb-Blaisdell Machine Tool Co. 19
Whitman & Barnes Mfg. Co.. 84
Whitney Mfg. Co. 90
Whiton Mach. Co., D. E.....106
Wiley & Russell Mfg. Co.... 90
Wiley & Sons, John..... 34
Wilmarth & Morman Co.... 92
Windsor Machine Co..... 88
Wood's Sons Co., T. B..... 96
Woodward & Powell Planer Co. 103
Worcester Mach. Screw Co...106
Wormer Machinery Co., C. C. 88
Wyke & Co., J. 84
Wyman & Gordon Co..4th cover

Yale & Towne Mfg. Co.....108

Classified Index of Articles Advertised.

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The College Shop.

BY DEXTER S. KIMBALL.

Educational institutions where shop work in the sense generally understood is included in the curriculum may be divided into three general divisions:

Manual Training Schools;
Trade Schools;
Engineering Colleges.

In each case the purpose of its presence is, or ought to be, different, even though the general character of the shop work used may be about the same.

In manual training the object of the shop work is mostly educational and is, when properly carried out, only a part of the general scheme of educational development where the particular shop work employed is not of so much importance as the manner in which the instruction is presented. Its true function is general, and not special, education, and it is rapidly becoming recognized in secondary schools as an important educational principle.

FIG. 1. WOODWOOD-WORKING EXERCISES FORMERLY USED IN SIBLEY COLLEGE.

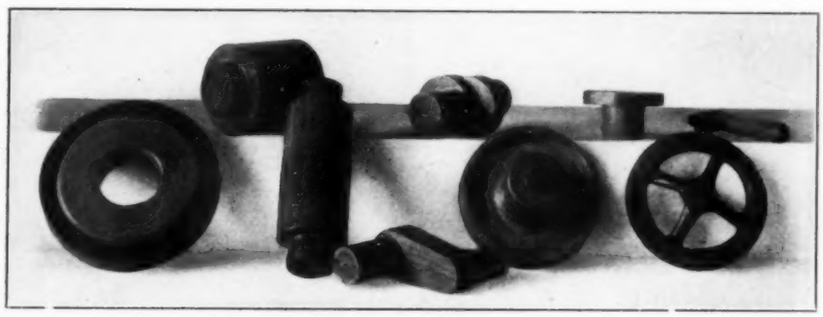


FIG. 2.

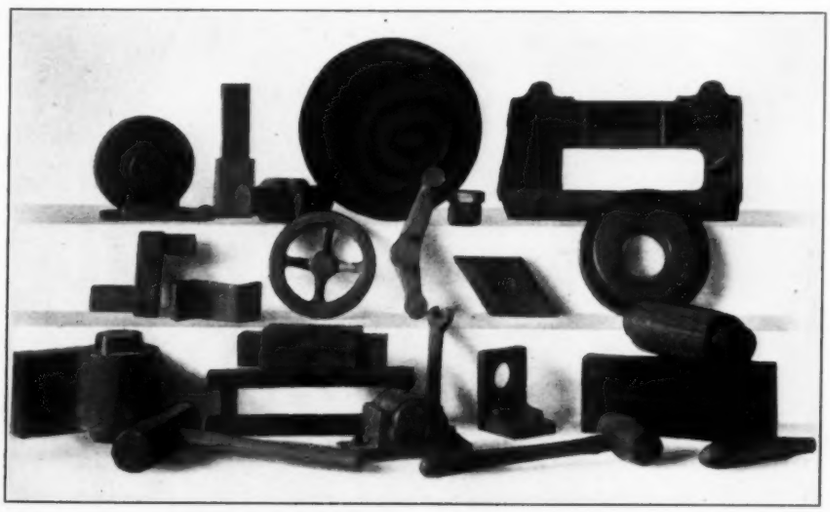


FIG. 3. WOOD-WORKING EXERCISES NOW USED IN SIBLEY COLLEGE.

The object of shop work in trade schools as practiced at present is very different, as here its character is generally quite definitely fixed by the particular trade or trades taught. The instruction, while it may be educational from a pedagogical standpoint, is designed mainly to develop manual skill and to prepare the student for a particular trade or calling as his lifework.

MANUAL TRAINING AND TRADE SCHOOLS.

The distinction between these two classes of schools is not clearly understood generally, even by many engaged in manual-training work. Manual training as at present developed in this country, finds its logical place in the high school or a manual-training school of the same grade. The boys and girls who constitute the class from which the trades are recruited find the high school beyond them, for obvious reasons, and manual training, even if suited to their needs, is out of their reach. No doubt there are some features of manual training that the trade schools of the future will do well to copy, but they are essentially two different classes of schools. This question of trade schools is a very difficult one and has never been satisfactorily answered. Private interests are in many places now taking the matter up, mainly for their own purposes, and it is to be hoped that these efforts will show the way to the correct organization of a Government or State system of trade schools, just as manual-training schools, at first organized privately, have made a place for themselves in our public-school system. Some kind of trade school must soon become an absolute necessity if modern manufacturing methods continue to move along their present lines; a discussion of this most interesting and important matter, however, is beyond the scope of this paper.

ENGINEERING COLLEGE SHOPS.

The object of shops in connection with an engineering college of the higher grade is entirely different, again, from that in either of the classes of schools already discussed. In order to get a clear idea of their purpose, a knowledge must be had of the object of the college itself. The purpose of Sibley College, the mechanical-engineering college of Cornell University, is summed up in the register as follows: "The college is organized to train men in the fundamental principles that underlie all mechanical engineering and to give such actual engineering work as may be possible in a technical school." The object of the college, then, is not to send out men skilled in any trade, but men well trained in engineering principles who may, with the addition of practical experience, make high-grade designing or superintending engineers.

Now, the principles governing shop work are among those which the young man should acquire, as the education of no engineer can be considered complete without a good knowledge of shop processes, and the better versed he is in these matters the stronger he is as an engineer.

The criticism is often made that these things are better learned in an industrial establishment, and to a certain extent that

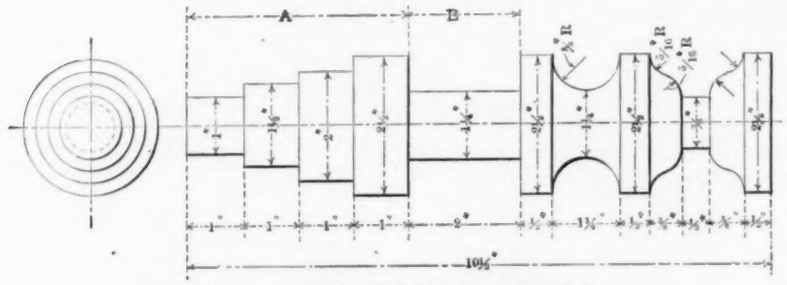


FIG. 4. TURNING EXERCISE IN CAST IRON.

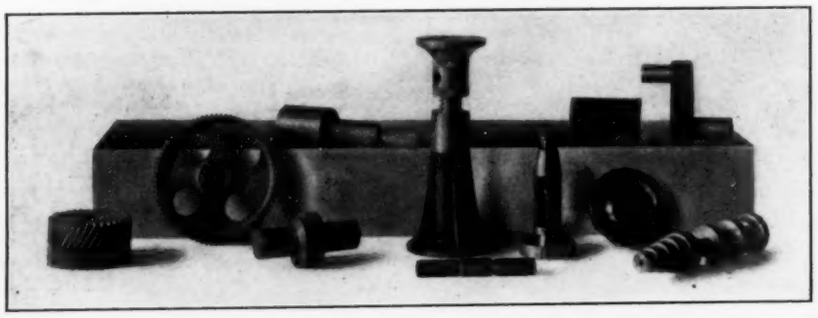


FIG. 5. GRADED EXERCISES IN METAL.

is true. Men who have had some years of practical experience before taking up their college work make the strongest students and best engineers, all other things being equal. But many cannot obtain this practical training first, and it is difficult to get those who could obtain it to do so. And those who do obtain their practical knowledge in this manner have often to do a great deal of unnecessary drudgery and uninstructive labor to acquire a fair knowledge of one trade and an extremely limited knowledge of several others (all of which are as important to him as the first), as I can testify from experience. Now, if a boy is to receive a technical education to fit him for the engineering profession, he has no time to lose on unnecessary work; and while it is conceded, therefore, that much of the information under discussion can be best obtained in shops of manufacturing establishments, there is a good deal that can be given to advantage in the college shop, while the young man is acquiring his more strictly technical training. This also serves a wise purpose in modifying his technical work along practical lines, and gives him some manual skill that will enable him to *do something*, small though it may be, during the trying time of adjustment immediately following graduation, when he is trying to acquire still further practical experience in some industrial works, which is the usual way in which a start is made. Further, a considerable amount of highly necessary information can be given him relating to all the trades with which he desires familiarity, which, as before stated, would take him a long time to acquire as an ordinary apprentice in an industrial shop, as his instruction is there confined generally to the one particular trade he is learning. Time would not permit him to serve an apprenticeship at all these trades, and the information which would be of most help must be picked up by fragments or is never acquired. How many machinists, for instance, know much about the molding trade except in a very general way? It is, however, necessary that an engineer or designer have a fair knowledge of all the trades with which his work is concerned, and it is more important that he should know *how* the various processes are performed than that he should be able to actually *do* a few of them perfectly himself. This is particularly well illustrated in the case of the designing electrical engineer, whose work requires that he have an intimate knowledge of machine work, and of the processes of winding and insulating the many forms of coils used in his business. It is not at all necessary that he be able to actually perform all these operations, and in fact, life is too short for any engineer to become such a versatile workman.

THE OBJECT OF THE COLLEGE SHOP.

It should be particularly noted, therefore, that the main objective of the college shop is not, or rather should not be, man-

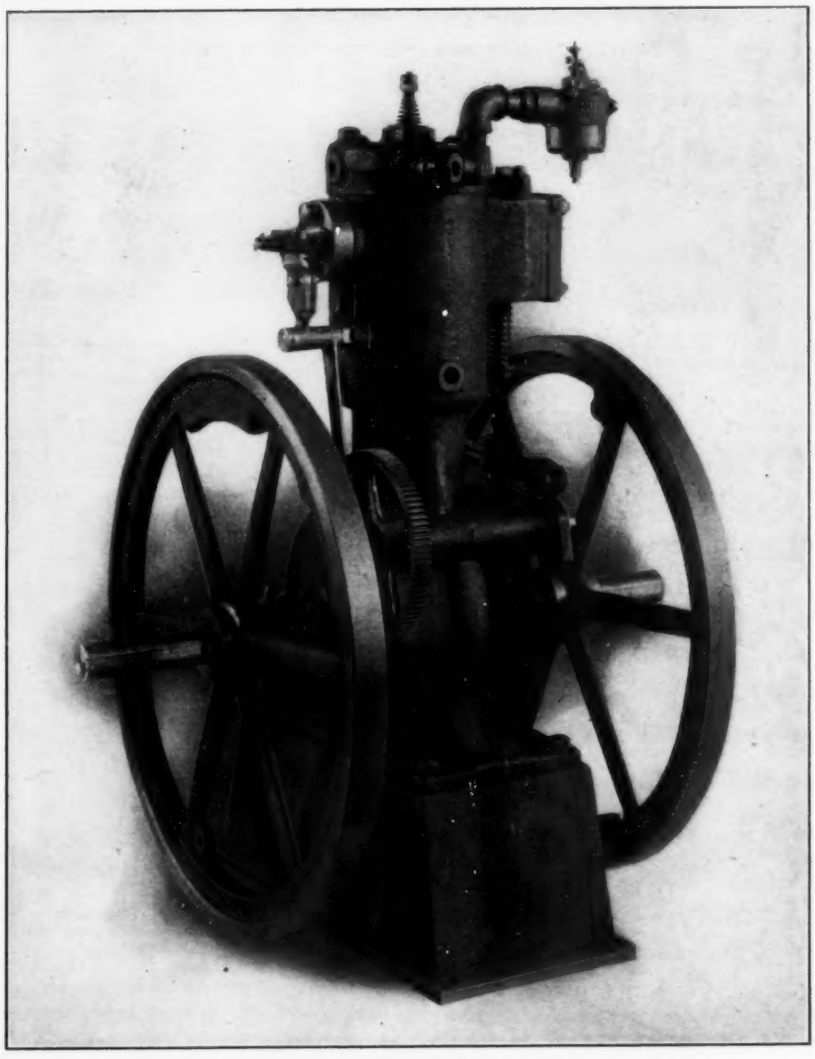


FIG. 6. AN ADVANCED PIECE OF WORK.

ual development. While manual development is highly desirable, as before stated, and while manual training in the wide sense must always form the backbone of all shop instruction, it should be accompanied in the case of college work with as full an exposition as possible of all the principles that underlie not only the simple operations of hand and machine work, but also the more complicated manufacturing methods, and even the business principles involved; for a knowledge of these generally is of as great, or greater, importance to the engineer than ability to turn or weld. If manual skill were the objective point with a view of assisting him in his lifework, it would be better to confine the student's efforts to one trade, as in the case of a trade school. Summing up the foregoing, then, it appears that the purpose of shop work in an engineering college should be to instruct the student in shop methods and processes; and next to this, to give him as much manual development as time will permit.

What, then, shall be the character of the shop and the instruction given to accomplish this result? Many answers to this question have been given, ranging all the way from shops modeled after and operated exactly as industrial establishments to the other extreme of no shops at all, but instead of them a system of visits to representative works under systematic direction and instruction.

Regarding the last method, there is no doubt that much good work can be done, and has been done, in this manner where proper facilities are at hand; but the great objection to it is that the boy can never thus acquire that intimate knowledge of materials and machines which can only be had by actual handling. Just as a student can never learn to successfully make an efficiency test of a gas engine by reading a carefully prepared set of directions, so the boy who wishes to know something of lathe work should run a lathe for a while and spoil a few pieces of work in getting acquainted.

FIG. 7. INTERIOR OF PATTERN SHOP.

THE COLLEGE SHOP AS A PRODUCTIVE ENTERPRISE.

The other extreme, that of shops operated exactly as an industrial works, is the one which at first sight seems the most logical, and is the one often assumed to be the best. It is argued that the boy will acquire more and better practical instruction in a shop doing actual manufacturing, and besides there would seem to be an advantage in having the student produce salable articles for the revenue thus brought in. Leaving out of the question the industrial conditions and certain phases of the labor problem now existing, which make such a shop a difficult undertaking, there are other difficulties and objections, at first sight not apparent, which seem to indicate that the above assumption is far from correct, at least in most cases.

Now, as before stated, the object of the shop is to teach processes, and it must be remembered that the time allowable for shop work in a high-grade engineering school is necessarily small, and, further, the instruction given must be uniform; that is, we must guard against one boy getting an excellent shop training and another little or none. As soon, therefore, as a student has mastered one process he must be, and should be, transferred to another; and the arrangement of the work given must be such that uniformity of instruction is secured, especially where large numbers are to be handled. Such an arrangement, however, does not agree very well with the fundamental laws of economic manufacturing, and machines produced in this manner, unless of exceedingly simple design, or unless mainly built and finished up by the instructors, are simply a collection of first efforts and valueless as far as accuracy is concerned. The student has no time for repetitive manufacturing processes and his time is more valuable for educational purposes. If the shops could be large compared with the number of students instructed, and if the student had more time for shop work (as was the case a few years ago, when the curriculum was not so crowded), shops of a commercial character as outlined above would be feasible and would no doubt give the very best results. But the problem of such shops to provide instruc-

tion for, say the 1100 students in Sibley College, where the total time allowable during the entire course for shop work is only 600 hours, is a most difficult one from either the standpoint of organization or finance.

THE LABORATORY METHOD.

For this reason nearly all colleges have adopted what is generally known as the laboratory method of shop work. That is, the student receives condensed instruction in the use of shop tools doing certain exercises, not necessarily parts of commercial machines, just as a student in chemistry performs certain experiments in the abstract. The shops are generally equipped with representative tools selected not with a view to the economic production of some line of goods, but with a view of teaching every man the elementary principles of the trades concerned, which is practically all that can be done in the time allowable. The broadening of the boy's mental horizon, which contact with a large commercial shop will give, must be left till after graduation, in actual practice, though something can be done in college by well-planned visits to large works. The method is perfectly logical and there is no reason why shop methods cannot be so taught. From a pedagogical standpoint there is no more reason why an engineering student should produce salable work than that a student of English literature should write salable novels or a law student defend a case in court.

But the best possible results have so far not been obtained by this method on account of certain inherent tendencies of the system. Unless the main object of the shops is kept constantly in view the work tends to become purely manual training in its character, particularly if the exercises should not be so chosen as to illustrate shop principles as well as develop manual skill, for therein lies the great difference between manual training as properly understood and carried out and the work as it should be in a college shop; for manual training may be highly successful without any reference to engineering or any special trade, although often the exercises used are of an engineering or trade character. Not only should the instruction cover the elementary principles of the trades concerned, but also the application and extension of these principles to manufacturing and the production of work in quantity, and the equipment of the shop should include such tools as automatic screw machines, turret lathes, molding machines and such other manufacturing tools as will best illustrate modern methods of production, and these matters are not always kept clearly in view.

MANUAL TRAINING AND INSTRUCTION IN METHODS CONTRASTED.

A few examples may make this clearer. Fig. 1 shows certain turning exercises taken from early work in Sibley College when the work was more of a manual training character, and they are typical of turning exercises and in many manual training and college shops of today. As manual training they are first class, serving well to devlop skill in the hand and train the eye to form. Figs. 2 and 3 show a set of exercises from the present course in Sibley College, and it is seen that while they possess some of the features of the first, they also illustrate several important engineering principles, as draft, finish, core prints, etc. So that, while exercises in general may be equally valuable as far as manual training is concerned, one may be much more valuable as an exercise for the engineering student. It would seem at first sight that the work shown in Fig. 1 would be more interesting to students than the work shown in Figs. 2 and 3, and in the case of younger boys this may be true; but for the class of young men found in engineering colleges the second is of much greater interest, as it has a direct bearing on their chosen life-work. In a similar way the work in the forge and foundry may, and should, be made to illustrate the elementary principles of these trades and the instruction and equipment should be such as to show their extension to the more advanced ideas before discussed.

FIG. 8. INTERIOR OF MACHINE SHOP.

APPLICATION TO THE MACHINE SHOP.

Comparing Fig. 1 with Figs. 2 and 3, it will be seen that while the exercises of Fig. 1 illustrate no constructive principle, those of Figs. 2 and 3 illustrate several. Thus in the latter we see patterns in one piece and others in halves, patterns which leave their own cores and others with core boxes. Of these last, again, of one the core is made in one piece, while in two others the box is a half box only; and again, one pattern is to be molded on its side and hence has straight prints, while another is to be molded on end and has taper prints. Still another pattern leaves its own core for one hole and has offset prints for two others.

It will be seen that with exercises like this, made from the students' own drawings and followed by their molding in the foundry, many of the essential principles of pattern making and molding, as well as some of economical design, can be impressed upon the student in a way which is likely to insure that they will not be forgotten.

If the foregoing principles are true for the shops considered, they are more so for the machine shop, as here the products of other shops are finally finished and the complete machine assembled. A great deal more stress is usually laid on machine work than on other shop processes, and there is good reason for this. It is doubtful if the kinds of shop work as now practiced at our best colleges are in all respects the best suited to the needs of technical education. It is generally taken for granted that a knowledge of pattern making, forge work, foundry work and machine work is necessary and sufficient. Regarding all except forging there seems to be no doubt. But modern methods have forced forging into the background to a great extent, steel castings taking largely the place of forgings; and, aside from the better knowledge of strength and structure of metals, which the student acquires by forging them, it is an open question if there are not other forms of shop work just as important and instructive. Thus to the electrical engineer a knowledge of winding, insulating, and stamping or press work is of at least equal importance, and few, if any, of these processes are covered by the shops of any of our colleges. But of the work of the machine shop there is no doubt, as here we find the greatest refinement of manufacturing methods as well as the greatest investment per employee. And the work of no other shop lends itself so readily to illustration of manufacturing methods. And whether the work offered consists of so-called exercises or parts of commercial machines, as far as possible each one should give not only practice on some particular machine, but should also illustrate some principle of shop practice or manufacturing method. Thus Fig. 4 shows a form of turning exercise much used, which illustrates this point. If the student is required simply to turn the piece to the sizes shown, by caliper and scale, or even to fit the various diameters to holes of standard sizes the exercise becomes purely one of manual training and use of the lathe. But require him to turn the dimensions shown at *A* several thousandths less than standard, using the micrometer, require him to finish the sizes at *B* to limit gages and explain to him the bearing this has on manufacturing, and the exercise has an added value more important to him than either the manual training or the exercise in the use of the lathe. Exercises of this character are much used and it can readily be seen how easily they can become purely manual training. If possible, therefore, the exercises should consist of parts of some commercial machine, and when such exercises are used for the elementary work, the more advanced work should be more of an engineering character. Thus Fig. 5 shows a set of graded exercises from the Sibley machine shop containing a few exercises which are not parts of a machine; but as soon as a student can do fairly good machine work, he is put on some part of a machine which is being built for shop use. Fig. 6 shows a gas engine just completed, and an 8x36-inch grinding machine and several other tools are now under construction in the shop.

FIG. 9. INTERIOR OF FOUNDRY.

Again, if the boy be shown how one piece of a certain form is produced on a standard lathe, then how a limited number can be more economically produced on a semi-automatic lathe, and finally how a great many can be still more economically produced on a full automatic, he receives an object lesson in manufacturing principles that he is not liable to forget. Again, if he is paid (in hours' credit) on the day's-work, piece-work, and premium plans, and the various aspects of these matters are explained to him, he goes out into the world with an insight into certain things of considerable importance to him in his near future.

Many such examples could be cited, but enough has been said to indicate what can be done in equipping the student not only with such manual skill as is possible, but also with some knowledge of these more advanced and highly important principles of manufacturing. And the introduction of these ideas takes away nothing from the actual work that can be accomplished, but rather acts as a stimulus, the amount of work done by the students working under such a system exceeding that done when the work is more of the manual-training character, the gain in production, where the premium plan is operated, being as great by actual trial as in actual practice.

FIG. 10. INTERIOR OF FORGE.

TEACHING SHOP ADMINISTRATION.

The question as to the desirability and possibility of teaching students these principles discussed above, and others, such as costs, timekeeping systems and kindred matters, a knowledge of which is so essential to the successful engineer, has been the subject of some discussion of late. Of the desirability there does not seem to be much doubt, and in Sibley College and a few others, at least, it is considered possible. In the Sibley College course a set of lectures bearing upon these matters is required of all men taking machine work, which comes in their junior year. These lectures are given in close connection with the shop work and are intended to give the students a knowledge of shop systems, the elements of costs in manufacturing and the means whereby costs are reduced. They are illustrated by the work in the machine shop to a considerable extent, and the administration of this shop is intended to give the student some idea of shop management. Time is kept on a regular Rochester time clock and much of the work is done on the premium plan, while production of work in quantity is illustrated on turret and automatic lathes. A similar course of talks is given to the freshmen bearing on pattern making and foundry work.

There is no reason why these matters cannot be discussed in college, as the principles involved are well understood, are not difficult of treatment, and form just as much a part of the engineer's working equipment as a knowledge of mechanics or machine design. In fact, successful machine design depends to a large extent on a knowledge of costs. And there is probably no part of his education so difficult to obtain in practice, as those who have so obtained it can testify. A good start, therefore, in college will greatly aid him in acquiring more complete knowledge in this direction.

THE TEACHING OF DRAWING AND OF SHOP WORK CO-ORDINATED.

In order also to bring home more clearly to the student the inter-relation of processes and the bearing of these matters just mentioned, the drawing-room work and shop work in Sibley College are conducted as one department, so as to get true relation between the various classes of work. Thus in the case of many of the exercises he makes a drawing of the piece as a drawing exercise, makes a pattern for it, molds it in the foundry and machines it in the machine shop, thus getting a clear idea of all the steps taken in its production. And the whole aim and purpose of the shop work is governed by the principle laid down at first of giving the student shop principles first and as much manual training as possible in the time allowed.

It may be of interest to know how much can be accomplished in college shops in the comparatively short time given, and

those who are familiar with the progress made by the average apprentice will be surprised at some of the results. It must be borne in mind, however, that the boys under discussion are necessarily bright, at the most receptive age, and that no time is lost in drudgery as in regular apprenticeship, every minute being devoted to work done under close instruction.

Fig. 3 shows a set of pattern exercises the result of the last 100 hours of instruction in the pattern shop at Sibley College, the first 100 hours being devoted to elementary carpentry and joinery for the purpose of becoming familiar with tools. The workmanship in the last piece made, which is in the upper right-hand corner of the photograph, would often do credit to many a journeyman patternmaker. It will be noted that these exercises cover the main points in pattern making.

Fig. 5 shows a similar set of exercises from the machine shop designed to cover simple machining in the same way. All students are required to make about the equivalent of this set, and the more rapid ones get an opportunity to do work on commercial machines, a sample of which is shown in Fig. 6 and already referred to. While this system of instruction is no doubt imperfect in some respects, it is capable of producing good results when properly carried out and is probably the best that can be done by most of the colleges with the means at their disposal at present.

As a matter of general interest Figs. 7, 8, 9 and 10 are added, showing interior views of the pattern shop, machine shop, foundry and forge shop, respectively.

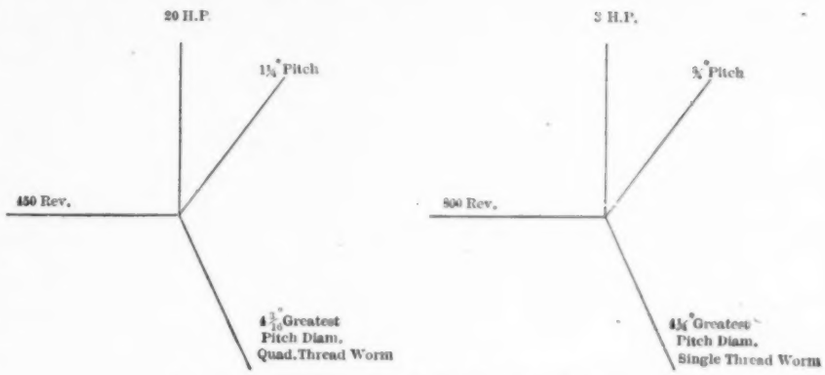


FIG. 1. SKELETON OF WORM GEAR DIAGRAM. FIG. 2.

Power Transmitted by Worm Gearing.

BY WM. H. RAEBURN.

There is no difficulty in getting reliable information about the loads that spur and bevel gears should carry, and even if authorities differ slightly, the designer can use his judgment and select data that are at least arranged in systematic fashion. In the case of worm gearing, however, the

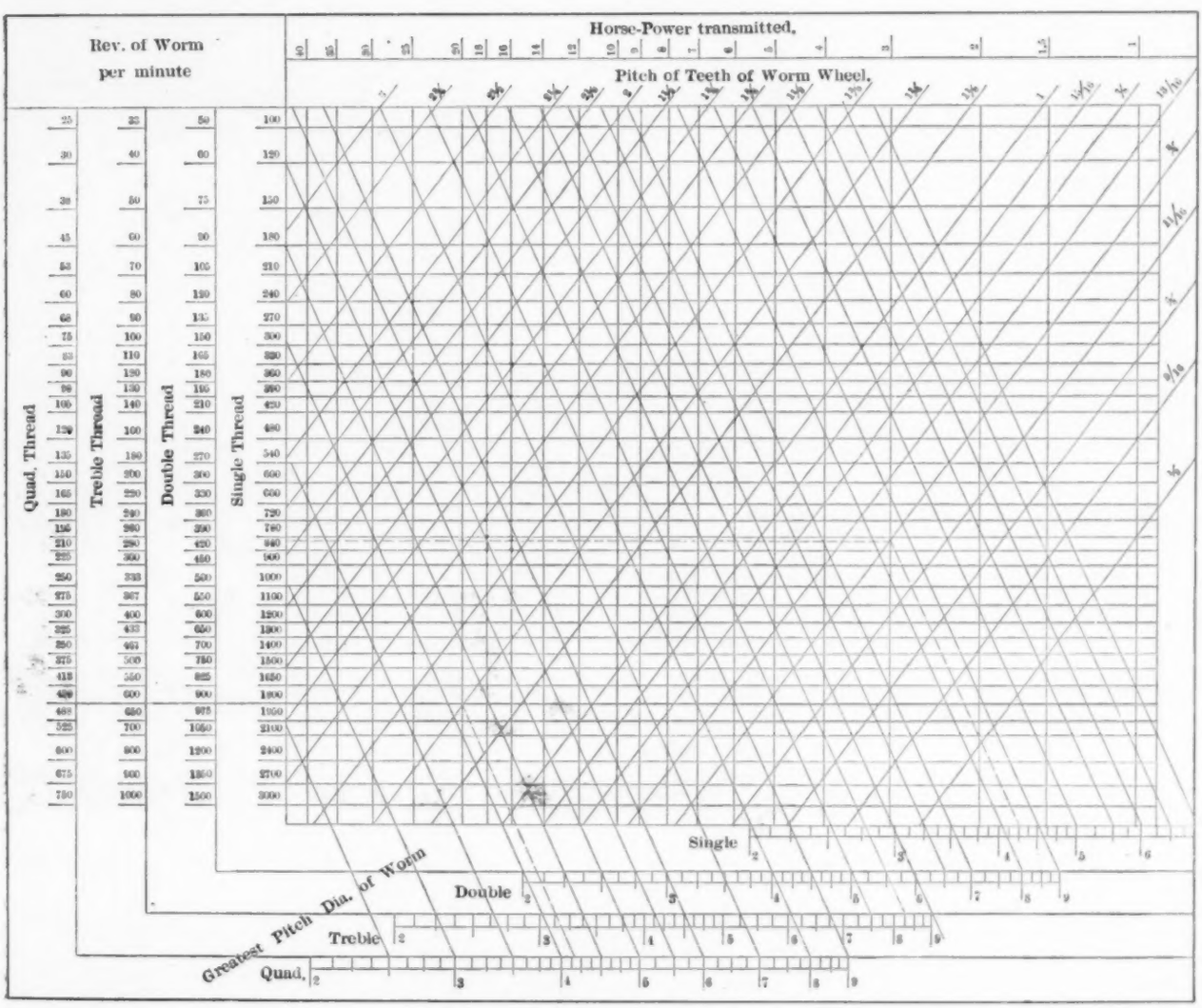


FIG. 3. WORM GEAR POWER DIAGRAM.

condition of affairs is not so satisfactory; in fact, there is no general formula in use among American engineers, so far as I am aware. The prejudice against worm drives is not dead yet, and many are chary about their adoption. If such would read that excellent work of Mr. Halsey's on "Worm and Spiral Gearing," they might have some light shed on the dark places.

Worm drives are being used successfully today—in fact, they have been so used for many years by those who were fortunate enough to adopt a worm in which the relation of diameter, pitch and speed produced conditions favorable to high efficiency, and we now read at page 127 of their adoption for electric tram-car work in Europe.

German engineers have at their disposal more data than we have, and a study of German practice, along with experience with successful worm drives on this side of the Atlantic, has led me to offer the accompanying diagram to the readers of the AMERICAN MACHINIST. We find that the best materials for these drives are steel for the worm and bronze for the wheel, or cast iron or steel for the worm and cast iron for the wheel.

A brief explanation will suffice to show

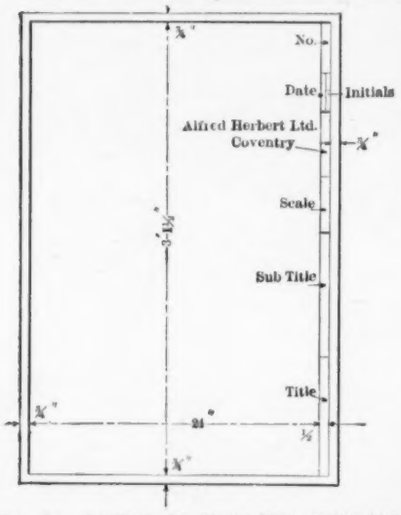


FIG. 15. LAYOUT OF SHEET FOR STANDARD SIZE DRAWING.

the methods of using the diagram. In Fig. 1 we have a problem in skeleton form as it were. A worm with quadruple threads is required to transmit 20 horse-power at 450 revolutions per minute. Entering the diagram on the horizontal line corresponding to 450 revolutions in the quadruple-thread column, we follow this line until it intersects the vertical line for 20 horse-power; from this point the inclined line running upward to the right shows 1¼ inches for the pitch of the teeth of the wheel, which makes 5 inches for the lead of the thread of the worm. The inclined line running downward to the right crosses the scale for quadruple worms at 4 3/16 inches, the greatest pitch diameter of worm that it is advisable to use. A smaller pitch diameter will of course give a higher thread angle and therefore greater efficiency, but if the diameter be increased we lose ground. Fig. 2 is a similar problem for a single-thread worm, and from these two examples the use of the diagram will be clear. It is evident that if we are given any two of the four quantities, the remaining two can be obtained from the diagram. In the case of drives where conditions are favorable to the use of rough cast teeth, the pitch as found by the diagram should be multiplied by 1.33 and the pitch diameter of the worm by 0.8.

The Allis-Chalmers Company have had built two flat cars, of 100 tons capacity, for the transportation of very heavy pieces of machinery. They are 41 feet long and have 16 wheels.

The manufacturing trades employ considerable zinc in the form of dust which is a by-product obtained in the production of that metal.

The Works and Methods of Alfred Herbert, Ltd., Coventry, England—II.

BY I. W. CHUBB.

The following particulars of some drawing-office and shop details will be of special interest: In the drawing office, as noted in the preceding article, standard part sheets, to the number of more than 150, are used. The system is even carried out for the dimensions of drawings, sizes of full and half-size drawings being shown in blue-prints, as in Fig. 15, for the use of new men. Stock sheets of work made on automatics and other standardized details are blue-printed from large tracings containing a number of smaller pages, and when cut up the parts are issued to the various departments in spring binders. In the case of stock screws, etc., each size has a symbol. By this it may be distin-

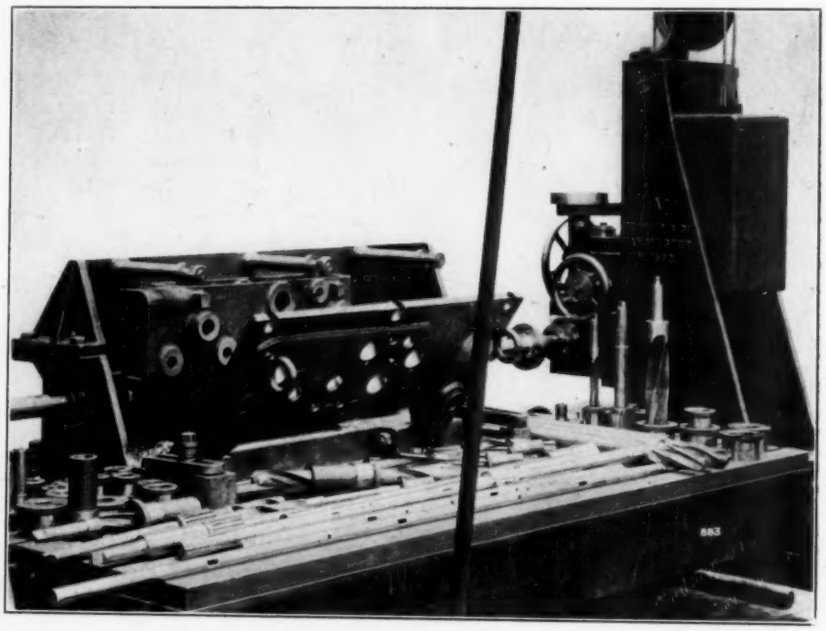


FIG. 16. BORING FIXTURE.

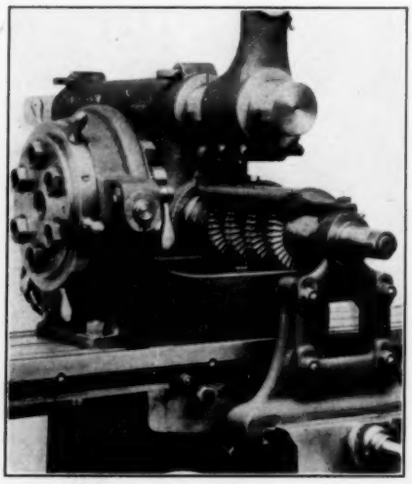


FIG. 17. BOLT HEAD MILLING ATTACHMENT.

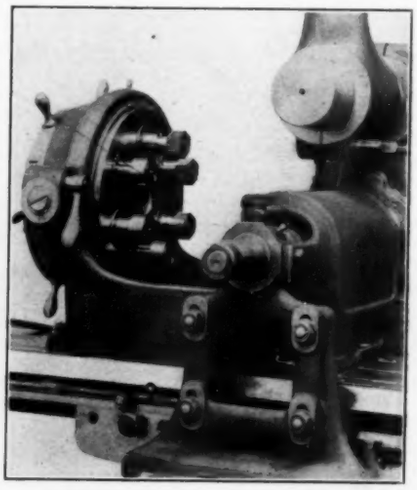


FIG. 18. BOLT HEAD MILLING ATTACHMENT.

guished in the shops without sketches being made every time. Wherever possible the maximum and minimum stocks to be kept by the storekeeper are tabulated, in addition to dimensions, etc. Many other things are included which can be standardized, but cannot be kept in stock, such as T-slots. The endeavor is to make the sheet as useful as possible to the workmen, and a broad line has been taken in deciding what is and what is not to go in it.

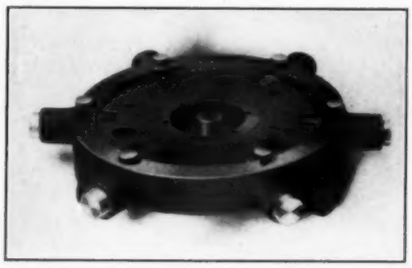


FIG. 19. HARDENING FIXTURE FOR INDEX RINGS.

In the practice of the firm, ball bearings are not used for heavy thrusts and square keys, one-quarter the shaft diameter, are the standard for solid shafts, no taper being given and the drive being on the sides. Then for spur gears involute form is used, diametrical pitch being employed.

SPECIAL FIXTURES.

As much as possible of standard work is machined by the aid of jigs and special fixtures and a good example of Herbert jig practice is shown in Fig. 16. This illustrates a horizontal machine boring the feed-apron of the No. 8 vertical milling machine, shown in Fig. 13. A large amount of work is necessary on this apron and all the boring and drilling is done by means of the jig, one side of which swings down, as shown, to facilitate the insertion and removal of the work. The various bars, tools, reamers and bushes used on the job are also shown. The small clips near the holes in the jig hold the bushings in position and prevent them rotating. The bushings on the machine table show how part of the flange is milled away for engagement of the clips.

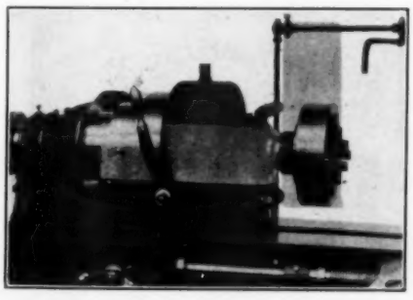


FIG. 20. AN OIL GUARD.

An attachment used for milling hexagon bolt heads is shown in front and rear views by Figs. 17 and 18. The attachment is used on an ordinary plain milling machine, and when the milling is fairly started, at each cut a bolt is finished complete on all six sides. Six cutters are used, one for each side, and three heads are operated on simultaneously, the attachment being indexed by hand after each cut. The sequence of operations can be gathered from Fig. 18. A similar attachment is made for dealing with square-head set screws.

Fig. 19 shows a device used for hardening the index rings for screw-machine turrets. The index ring, to be seen in position on the fixture, is made of tool steel and, in order to secure the required resistance to shock, should be hardened in the neighborhood of the index notches only. It is therefore uniformly heated in a gas furnace and is then placed in the fixture. This has six nozzles, which enter the notches. Water being turned on, is forced with considerable pressure through a number of small holes in the nozzles against just those surfaces which require to be hard. The remainder of the ring cools slowly and is therefore soft. The nozzles can be adjusted radially to suit rings of different sizes.

A chuck guard which has been found very successful is shown in a ghost picture, Fig. 20, the guard being in two positions. It effectually prevents oil or suds flying in the face of the workman, but can easily be swung out of the way to enable him to get at the chuck to open and close it.

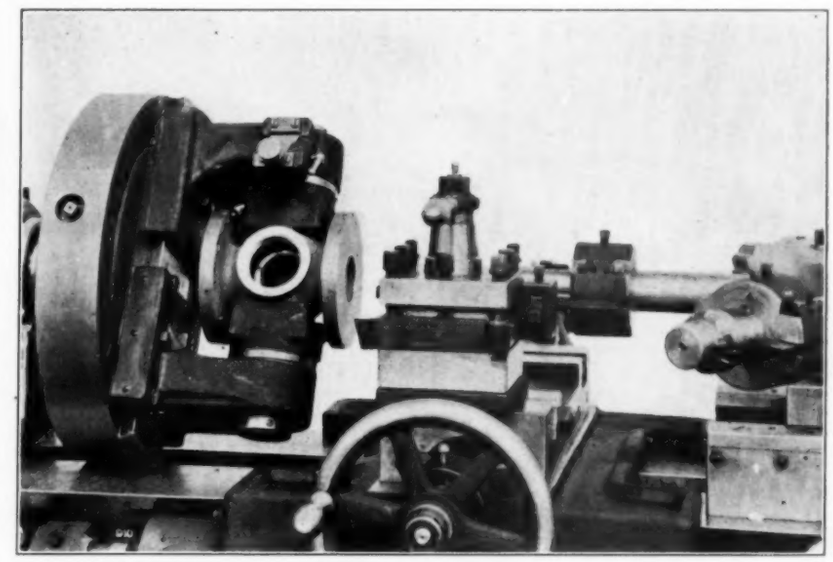


FIG. 21. TURRET LATHE WITH VALVE TOOLS.

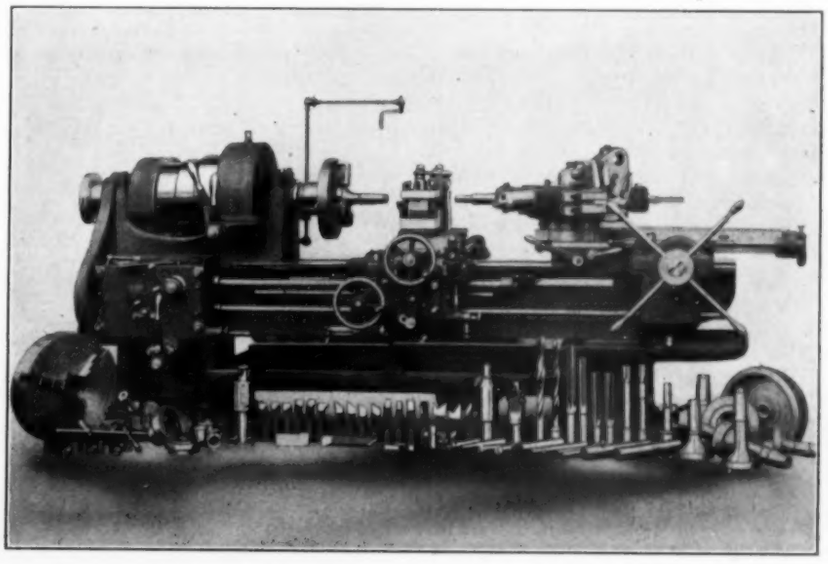


FIG. 22. TURRET LATHE WITH EQUIPMENTS FOR MACHINING MOTOR CAR TRANSMISSION PARTS.

TURRET-LATHE EQUIPMENT.

The firm supplies many special tool equipments to meet various requirements, and a selection of them, relating to lathe work, is here offered. Thus in Fig. 21 is a capstan lathe, having a chasing saddle, with tools for machining 2-inch

gun-metal valves. These are held in a revolving chuck, in which the thrust of the jaws is taken by ball bearings. The turret carries six tool-holders, the nature of which can be readily seen. The saddle also carries a supplementary square turret holding four tools, including the actual chaser. Obviously it is of great advantage on such work, where the number of operations required to finish the various faces of a valve are large.

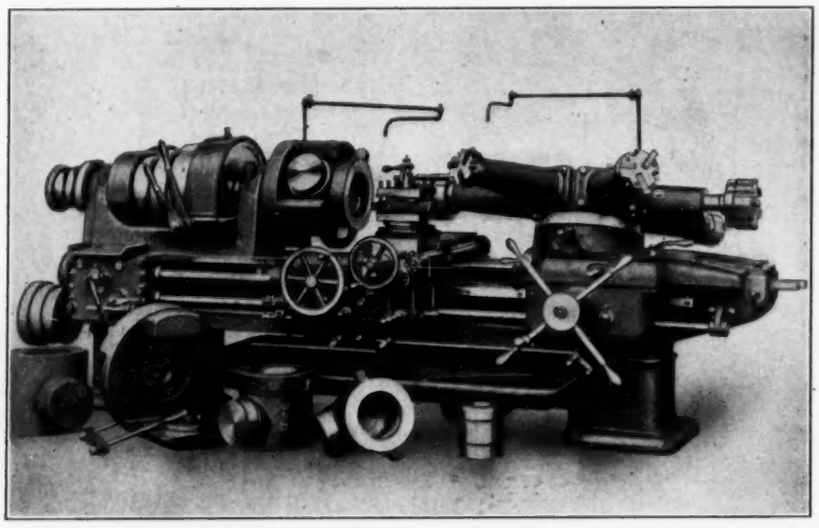


FIG. 23. TURRET LATHE EQUIPPED FOR MACHINING HYDRAULIC JACK BODIES.

A turret lathe with tools for machining parts of motor-car transmissions will be seen in Fig. 22. In general features it is similar to the machine in Fig. 21, but it is of rather larger size. The main turret is hexagonal, the tools being carried in holders bolted to the flat faces. Each face has an independent stop, the stops being carried on a hexagon bar at the front of the turret slide. This bar is rotated by gearing from the turret. Both the top and bottom slide can be moved along the bed by rack and pinion. The saddle has a chasing arrangement, with simultaneous quick-withdraw movement for guide nut and tool, and has also independent longitudinal and transverse feeds in each direction, with four separate automatic stops to each feed. Each leader or lead-screw will cut four pitches, suitable gearing being provided in the feed box. The feeds for the turret slides and the saddle, which are driven by a splined rod along the front of the lathe, have eight changes obtained in the feed box. The various feeds and chasing arrangement of this lathe are interlocked to prevent engagement of two conflicting feeds at the same time. In the illustration the various samples of work dealt with are shown on the floor, at the right-hand end of the lathe. Similarly the whole of the tool outfit is shown either in position on the lathe or on the floor in front of it.

A combination turret lathe is shown in Fig. 23 as equipped for machining hydraulic-jack bodies. These are made from steel forgings, an example of the rough forging being shown on the floor, at the left hand. The lathe is shown set up for the first operation, the various boring tools, reamers, turning tools, etc., being in position. The turret also has a holder which, entering the hole in the job, is used for removing it from the chuck. The fixture for the second operation, locating by the hole bored at the first operation, is shown in front of the machine.

MACHINING ARMOR-PIERCING SHELLS.

Fig. 24 shows the same machine equipped for machining 6-inch armor-piercing shells and their soft caps. The shells are made from very hard metal and are a severe test of turret-lathe methods as compared with the old way of doing simple operations on a number of different machines. The objects on the floor, near the right-hand end, are not form tools, but formers. They fit in the square turret and actuate a special form-tool holder, which is seen in its working position attached to the hexagon turret. Fig. 25 shows the first operation of boring the hole in a shell and turning the outside simultaneously. Then Fig. 26 shows the same lathe equipped for making melenite shells from the solid bar. The shells are bored and chambered, the chambered hole being taper. The taper chamber is bored out by a single-point tool, which can be seen at the front on the hexagon turret, the taper-former being carried on the square turret. For machining the point the body of the shell is supported on plungers which act as steadies. The point is turned by a tool carried on a slide at the front of the holder. This slide, which can just be seen, is actuated by a former bar carried by the square turret. Finally, Fig. 27 shows how armor-piercing shells for quick-firing guns are produced on the Herbert automatic screw machine. This admits bars up to 3½ inches diameter and has a pentagon form of turret, the cutting tools being provided with oil jets on each side for lubricating and clearing the chips out of the hole. The shell goes through the following operations: (1) Center and face the end to dead length; (2) rough bore the hole from the solid and turn the outside parallel at the same time with tools carried on the turret; (3) finish bore the hole with tool carried on the turret; (4) support by revolving steady carried on the turret and form parallel portion and groove for gas check with tool carried on the steady; (5) form point of shell with form-tool carried on the back of cross-slide; (6) cut off with tool carried by supplementary slide on the front of cross slide.

London, England.

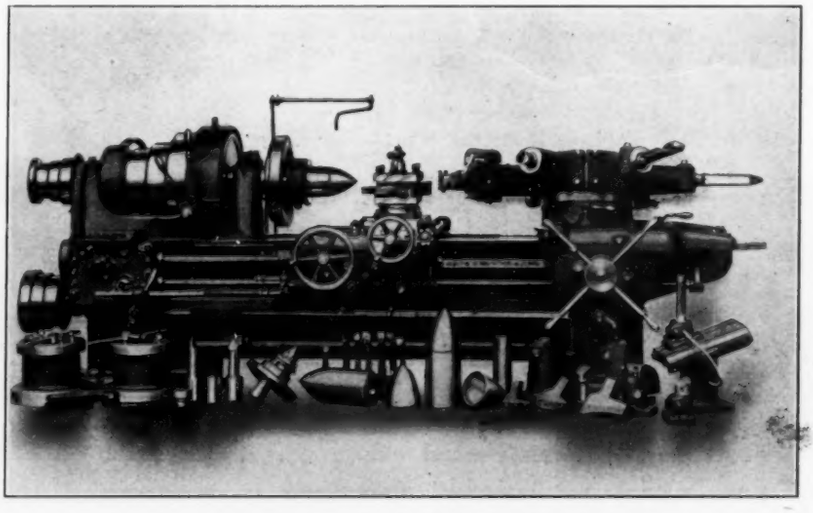


FIG. 24: ARMOR-PIERCING SHELL EQUIPMENT.

The patent laws of Mexico are very liberal and afford good protection to inventors, which fact American inventors should bear in mind.—*The Metal Industry.*

Tin has been known from remote antiquity and as early as the eighteenth dynasty in Egypt bronzes containing 10 per cent. of tin were used for tools and other purposes. —*The Metal Industry.*

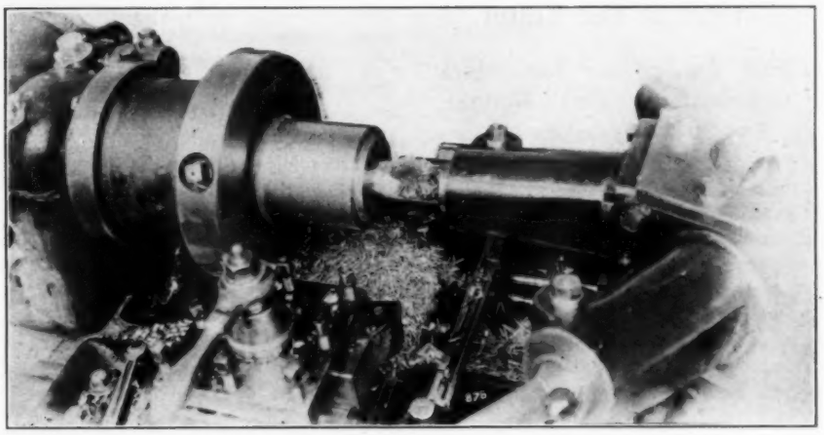


FIG. 25. BORING AND TURNING ARMOR-PIERCING SHELL.

The Best Machine Tools Made in Canada.

Probably very few of our readers have avoided being confronted with the problem as to who makes the best machine tool for a given purpose. It is generally recognized as being very difficult, if not impossible, to decide this point, or to have it stay decided when a decision has once been reached. The "United States Trade Reports," of Cincinnati, with its "staff of experts" to make investigations and report, has no difficulty in solving this problem, however. Not only can it decide with respect to one tool, but it can decide, and has decided, with respect to all tools. Toward the latter part of last year it sent to the London Machine Tool Company, of London, Ontario, Canada, a letter proposing to publish the results of its "decision" on this point, and at the same time making the usual suggestion regarding the purchase of copies of the paper in which said decision was to be printed. The London company was so cruel as to neglect replying to the letter, but has sent it to us with the article which the U. S. T. R. proposed to publish. We do not think it has been published, but it is too rich to be suppressed, and we therefore give it the publicity it deserves. It is as follows:

THE BEST MAKE OF MACHINE TOOLS.

"We fully appreciate the difficulties the prospective buyer finds in obtaining a truthful and correct answer to the question, 'Which is the best make of machine tools?'

"In the first place, he himself cannot know all the different kinds, and therefore cannot decide for himself.

"Second, he cannot depend on the opinions of others, as they, like himself, cannot know all the various makes, or may be prejudiced in favor of the kind they use.

"Third, he cannot take his choice from reading matter and advertisements of manufacturers, since one and all, believing they are right and justified in saying so, claim their respective make the best.

"Fourth, he cannot expect to have his question answered by any journal devoted to the trade, for in so doing such journal would commit financial suicide, since all other manufacturers, except the one given as the best, would at once withdraw their advertising patronage.

"In view of the difficulties to a correct decision, this paper decided to make a thorough investigation, the result of which, would be a decided answer as to which is the best. We fully realize the responsibility of making such a decision, since we are aware that our readers will accept it as final and worthy of fullest credence. For the benefit of new readers we wish to state that such faith on the part of our old readers is caused by their knowledge of the invariable method pursued by the Reports, by which we can conscientiously give an independent and unbiased report on any article manufactured. This method consists in examining closely all the various makes by means of our editorial and reportorial staff, without the knowledge of any manufacturer interested, and further without making any charges, accepting any gifts or soliciting any advertisements from any one whose wares we may pass upon.

"As a result we are prepared to state that there is no make of machine tools on the market today equal to those manufactured by the London Machine Tool Company, of London, Ont., Canada. These tools are made of the best material, are durable in use, perfect in construction and will give entire satisfaction at all times.

"The company is thoroughly reliable in every respect and can be depended upon. Their business is conducted on a line that is pleasing to each and every customer, and promptitude is a special feature of

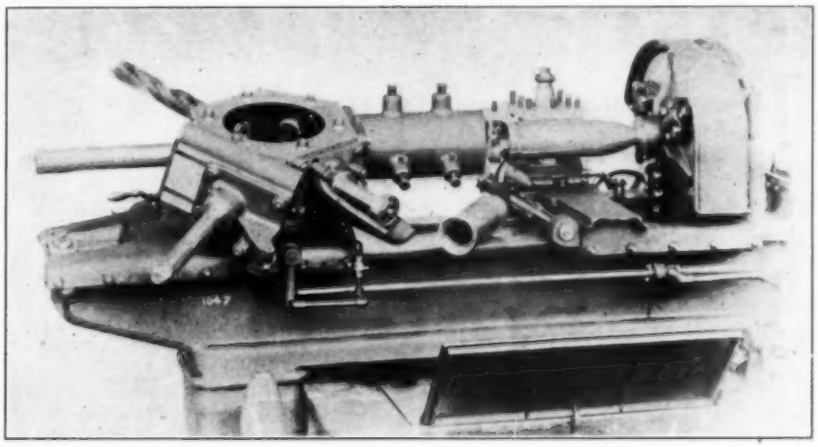


FIG 26. MACHINING MELANITE SHELLS.

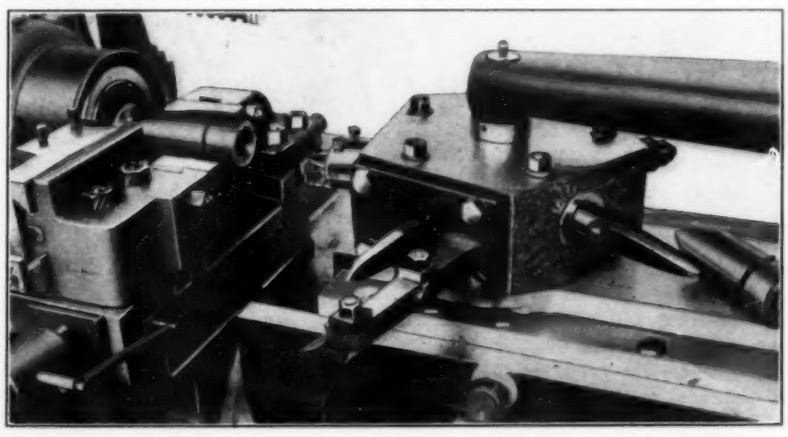


FIG. 27. MACHINING SHELL FOR QUICK-FIRING GUNS.

their business methods. They also stand high commercially.

"Our interested readers will do well in addressing them direct, as we are sure that all dealings with them will prove mutually beneficial and profitable."

The U. S. T. R. being published in Cincinnati, there may possibly be someone connected with it who could distinguish between a machine tool and the Chilkoot Pass, but "that's all."

Exposition Visitors — Motor Skates.

Those of our readers who have spent some time at one or more large expositions will recognize the type of individual who appears in the following anecdote.

At a San Francisco garage, out of a number of people surrounding a Winton automobile chassis, the salesman picked out the most likely looking, and showed him all the interesting points of the machine—the valves carbureter, transmission, rear axle, gasolene-supply system, etc. The prospect seemed promising, was no doubt interested, and the salesman felt much encouraged, until on taking leave, his probable purchaser thanked him for his information and remarked, "It certainly is wonderful the progress which has been made in electricity."

This reminds us that, as we surmised and intimated, the newspaper reporter who wrote the account of the motor boots, referred to on page 177, got the thing twisted. From later accounts we find that it is a little air-cooled gasolene engine, 1½ h.p., which drives the skate through connection to the rear axle, the engine being of the inside fly-wheel type as used on motor-cycles. The igniter battery and coil are carried on the boot or skate, while it is a gasolene tank which is carried at the waist of the passenger. In addition to the tubes carrying the gasolene, wires are led from the body of the passenger to the skates, so as to locate the switch of the ignition circuit convenient to his hand. It is stated that the front axle of the little trucks swivel, but in the absence of a steering wheel, we do not understand how the position of the axles is controlled. These skates were exhibited at the French automobile show.

We have received the Year Book for 1906 of the Merchants' Association of New York, which has its headquarters in the Merchants' Association Building, 66 Lafayette street, New York City. The Year Book gives an account of the work which has been accomplished by the Association during the past year, and is a record of which it may well feel proud. This association is one which might profitably be imitated in many cities. It represents and stands for the interests of the business men of New York, which interests are often opposed or neglected by the people's regularly elected representatives.

Letters to the Editor.

Thrust Bearing and Jump-Spark Commutator for Small Marine Two-Stroke Cycle Gasolene Engine.

In reply to G. E. L.'s request at page 121 for sketch of thrust bearing and jump-spark mechanism, I send the following:

A represents a small babbitted bearing for the shaft, and *C* and *C* are hardened steel washers, *E* and *E* are brass disks having holes large enough to admit ⅜-inch steel balls freely. *D* and *D* are hardened steel collars provided with set-screws to hold them firmly in place. Then when all parts are put together the brass ball cage, which is a loose fit on the shaft, keeps the balls in place.

This bearing will take the thrust in either direction but it is the usual practice in cases where the propeller shaft is direct-connected to the engine to place the ball-thrust collar so that the thrust is taken directly against the frame of the engine on the ahead motion, while very often no thrust collar is provided for the astern motion on such small boats, as the reverse is not often used for any great length of time, and the shoulders on the crank shaft will take the thrust for a short time.

The timing device for the spark is made as follows:

Make a brass casting *K* and bore it to fit the shaft. Then make a piece of hard fiber like *J* and fit it tightly on *K*. Then turn the outside so that the fiber and projection on the casting are a round true surface.

Make a lever *A* and bore so that it is a running fit on the shaft.

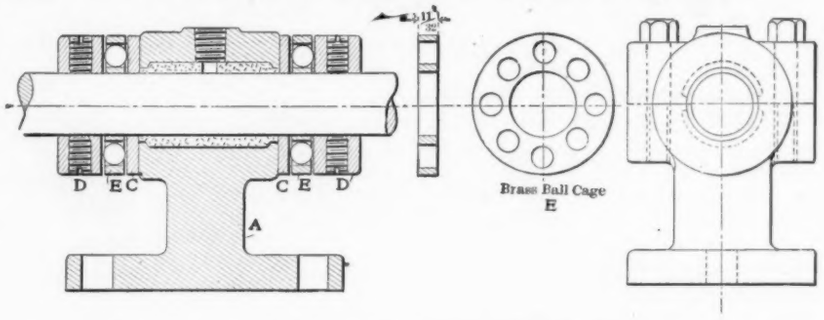


FIG. 1. THRUST BEARING FOR MARINE GASOLENE ENGINE.

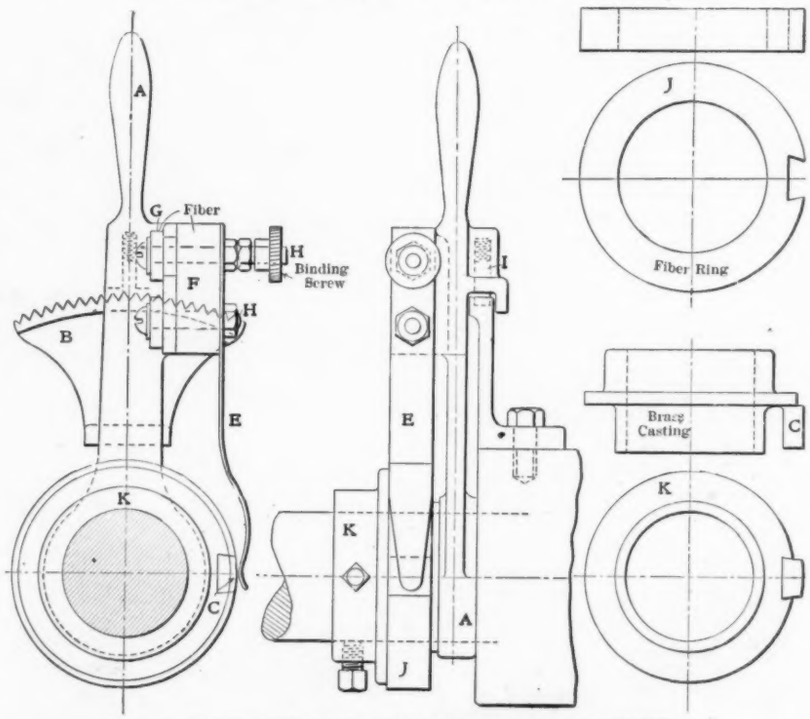


FIG. 2. SPARK COMMUTATOR FOR MARINE GASOLENE ENGINE.

Make a block of hard fiber *F* and two fiber thimbles *G*. Make a spring *E* and fasten it to the lever *A* by the two screws *H*, using the fiber thimbles *G* to insulate the screws from the lever *A*. Then the spring *E* and screws *H* are insulated from the engine except when the point *C* of the contact cam comes under the end of the spring, at which time the contact is made and the spark occurs.

B is simply a notched segment for locking the lever in any desired position

and the small wire plunger *I* is sufficient to hold it and at the same time is yielding so that the lever can be readily moved.

The wiring is done as follows:

Four dry cells are connected in series and one of the terminal wires *I* (see Fig. 3) connects to one of the primary terminals *M*, while another wire connects the other terminal of the spark coil to any convenient part of the motor.

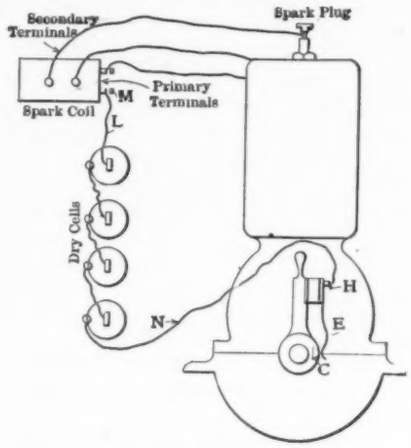


FIG. 3. JUMP-SPARK WIRING DIAGRAM.

The other wire *N* of the batteries is connected to the screw *H* of the timing device. The two wires from the secondary terminals of the spark coil are connected, one to the spark plug and the other grounded on the motor. The contact cam *K* should be set so that with the lever in the middle position the point *C* will touch the spring just before the piston reaches the end of its stroke.

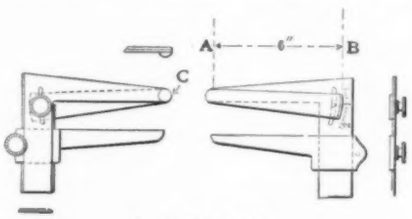
If the above device is carefully made I believe it will be entirely satisfactory.

W. ALTON.

A Taper Gage.

At page 321, I notice an article on the above subject by H. E. R. Manbrand. I think Mr. Manbrand's idea is good.

The sketch shows a taper gage I made three or four years ago, and is one of the handiest tools I have at present. The edges of this tool must be narrow, say 1/32 inch. The lower jaw slides up or down to adjust to the work; the upper one swings on a stiff joint *C* to adjust to the taper; both jaws are locked with thumbscrews.



A TAPER GAGE.

As it is half a foot from *A* to *B* the graduation is made one-half size ½ inch reads 1 inch to the foot taper, making it read the same as a lathe taper attachment.

We will suppose your lathe centers need replacing; set the gage to the old center, then set the taper attachment the same as the gage to turn up the new one.

This tool is easily made by any machinist, and as I never had it patented the readers are welcome to it.

Iowa. H. J. CHINNECK.

Diagram for Brake-Strap Calculations.

The following diagram simplifies to a certain extent the calculations of the tensions in a belt or brake strap. The common expression for these tensions being common log. $\left(\frac{T_2}{T_1}\right) = 2.729\ \mu\ n$, where μ is the coefficient of friction for leather on metal, commonly assumed at from 0.3 to 0.4, and n is the fractional part of the circumference embraced by the belt.

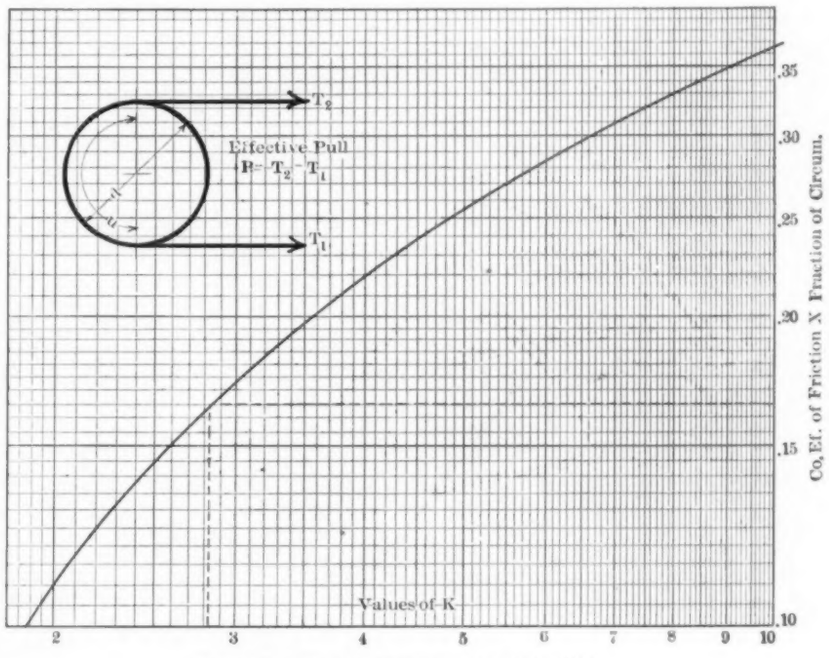


DIAGRAM FOR BRAKE-STRAP CALCULATIONS.

To use the diagram it is only necessary to find the product of $\mu\ n$ on the right-hand vertical, run across to the curved line and read the value of $\left(\frac{T_2}{T_1}\right)$ or K at the bottom. For example, with a coefficient of friction of 0.33 and ½ the circumference in contact, the product is 0.165. The corresponding value of K is seen to be 2.82.

It will be seen that while the formula is true for both belts and brake straps, in practice certain modifications have to be made; that is, the proportions must be such that a belt will not slip, while a band brake must slip. Several applications of this device occupy a middle ground; for example, a friction drop where a continuously revolving pulley raises the drop when sufficient pull is exerted on the free end of the strap or band. Another simple application is to the feed of a certain mortising (wood-working) machine, in which the feed pulley is driven through gearing. A strap passing over the pulley is fastened at one end to the table and is provided with a treadle or stirrup at the other. When sufficient pressure is put on the stirrup the increased friction causes the table to rise at the rate determined by the speed of the feed pulley. Some interesting experiments were made with this machine, the results of which I hope to present later. JAMES A. BROWN.

A Proposed Apprenticeship System.

The article at page 319, setting forth the apprentice system, has been read with a great deal of interest, as I served my time under similar conditions.

I was taken in the shop on three months' trial. When three months had passed the superintendent called me into the office and told me I showed mechanical ability, and had me sign a contract agreeing to stay with them four years from the time I entered the shop. The contract stated that I was to receive 75c. per day the first year, 90c. per day the second year, $1.05 per day the third year with a bonus of $75 to be paid at the end of the fourth year, and the last or fourth year I was to receive $1.25 per day with a bonus of $100, the full amount of bonus, $175, to be paid at the close of my apprenticeship. The contract also stated that I was to have two weeks vacation every year, one week in the summer and one week in the winter; pay to go on just the same during my absence. As the company had all the work they could do, I worked the most of my vacation weeks and received double time for them, which was a godsend to me at that time.

I had not found any better system since, and I think with the addition of the tool kit as suggested by Texas, the apprentice contract would be ideal.

J. FRANK RICHMAN.

Lansing, Mich.

A Collection of Comments.

Recent numbers of the AMERICAN MACHINIST have contained an unusual number of things that caught my eye. When I began Mr. Plaisted's article at page 383 I thought he must have been to Worcester, but as I read along and found him wondering where all the old machinists went to, I decided that he must have missed that city. Those that he didn't see in Springfield, Vt., are in Worcester. That is they stay in Worcester till they are 70 to 75 years of age, which seems old to me. Then they go out on a farm somewhere around and chop in the woods and make hay and do other light work till they die. And Mr. Plaisted need not worry about them either. Most of them draw pensions enough to pay for their tobacco and clothes and they get full measure out of life to the last. If Mr. Plaisted will tell me where all the young draftsmen go when they get old, I'll let him quit even.

Mr. Waterman with his article on Apprenticeship and Industrial Education at page 390 struck just the right key. The only trouble will be that someone will read this and jump at the conclusion that he can start right in and turn out a carload of apprentices that are worth $2.50 the day they are out of their time. Some of them can, more cannot. Mr. Waterman can because he is a great big fellow with a head and a soul that loom up as big as his body. He knows how to do work, can do work and will do work, and no man or boy has nerve enough to stay in the shop where he is without doing work. More than that he was a boy once, and not a great many years ago either, and he hasn't forgotten how it felt, and more than all that he goes right straight along on the assumption outwardly at least, that everybody is going to do his best. When one steps in the door of that shop he feels instantly that the shop is making money and men. I don't want to say that apprentices cannot be run to advantage without a man like him, but I do know that with a man of this kind around any kind of an apprenticeship system or lack of system will go.

Then, I read Mr. Butt's article at page 391 on proportioning things and it occurred to me that here was a good chance to inquire why? to the question of outside diameters of bearings. I now use about the proportions which he shows and make the thickness of metal about equal to the radius of the shaft because I do not want people making fun of me. Before I got to the state where I was sensitive to ridicule, I designed some hanger boxes for a countershaft. I had just been doing something in the way of designing a ring-oiling ball-and-socket pedestal box and in order to get the outside of the box to a size where it looked reasonable, I had to cut the box itself down pretty thin, and I made my hanger box the same way, about ¼ inch thick at the end and 7/16 at the center for a 1 15/16-inch shaft. A lot of those hangers were made and a lot of them are running yet with no trouble whatever. The only trouble that I had occurred before the hangers were put up. One man refused to use them till he had heavier boxes and we had to furnish them to get him to take the machine at all. I tried to make him see that when those boxes were worn out 1/16 inch that they were gone and so long as they were stiff enough not to deflect perceptibly in their length that more metal was a waste. So I will ask again why it is that a stationary box needs a lot of metal around the shaft and a swiveling box. if covered up, needs only a little?

The question of whether a machinist should sit while working has interested me all along. My father was one of the old-school style that got nervous if he saw a man sitting down in front of a drill press even if it was so low that it was almost impossible to stand to it. From the employer's point of view I should say that if by furnishing seats the men can turn out more work, then it is good business to furnish the seats and see that the more work is forthcoming. The man may be able to do more work for two reasons; one because it is handier for him, the other because the physical drain of standing on one's feet all day is exhausting to many. To get the work, either get a good foreman, or else adopt a piece-work or premium plan and get a good inspector. From the workman's point of view there is a chance for a difference of opinion. Some men can stand up all day and never notice it, others cannot. If they are working on piece rates each man will use a seat or not, just as he can make the most money and that will take care of itself.

I can sympathize with Mason (at page 355) in his feeling about the shop and drafting-room, but on the other hand there are cases where the drafting-room people are so cock-sure and feel so much above the greasy mechanic that they incur the natural enmity of the latter. I think that if I ever get to designing again I will see to it that the foreman who is going to work up my designs knows what I am working on all the time and I shall take him right into camp on all questions of his convenience. To be sure he will no doubt often claim that parts of my design are his suggestions, but I can afford to let him have some credit for the sake of having things go smoothly. This fear that someone else will get the credit for the location of a set screw or a rounded corner keeps a lot of people in hot water.

ENTROPY.

Another Thing that is Usually Wrong.

The article at page 361 giving figures for planing dovetail slides, revives a discussion of the subject presented so long ago, in the AMERICAN MACHINIST or *American Artisan*, that another generation has grown up and I beg to present it again for the consideration of those who care to reason out the right and wrong of things.

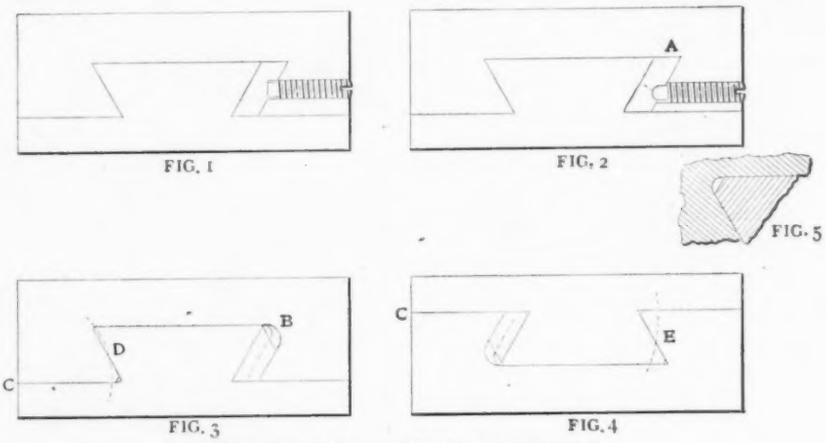


FIG. 1 FIG. 2 FIG. 5

FIG. 3 FIG. 4

RIGHT AND WRONG WAYS OF MAKING GIBS.

In the old days when gibs, such as shown in Fig. 1 were used, they were set up by a number of screws placed as shown, which was all wrong. The point of the screw should have a bearing as shown in Fig. 2, the bearing being at a point central with a line at right angles to the wearing surface. This being the case, there is no call for cutting out the stock and extending up the gib at *A* but they may be made as at *B*, Fig. 3, and if the gib is a tapered one, as used in all modern work of any pretensions, this gives all the solid bearing that will do any good. No wear comes on the narrow side of the gib and the small bearing leaves a strong corner in the slide, requires less work and the pressure being central the wearing surfaces will endure longer. Why they

are ever planed up to a dead-sharp angle is more than any one can explain. The delicate angle is too frail to stand much strain, it breaks or bruises off easily and a blow that would knock off a piece ⅛ inch deep, would have no effect if the angle were flatted off 1/16 inch as shown enlarged in Fig. 5.

The cross slides of lathes are usually wrong side up. Comparing Fig. 3 with Fig. 4 will illustrate the point. In using the lathe for boring the strain tends to rotate the slide around *C* as a fulcrum. As the resistance to the tool forces the slide tight against the surface *D* Fig. 3 and *E* Fig. 4, in Fig. 3 the lever arm is short and the angle nearly in line with the circle struck from point *C*, while in Fig. 4 the lever arm is much longer and the slide more nearly at a right angle to the circle struck from the same fulcrum.

JOHN E. SWEET.

An Internal Milling Fixture.

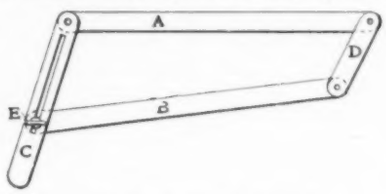
The fixture shown herewith was designed for the purpose of milling and slotting four radial lugs in rings similar to the one shown in the upper left-hand corner of the drawing.

A is a saddle to be clamped to the milling-machine table. The upper side is dovetailed and fitted with a gib, forming a slide for part *B*, when the work, clamped in a vise on the milling machine table, is being fed to the cutter *C*. Gears *D* form a train to transmit motion to the cutter from the spindle of the machine which has an arbor passing through the bearing *E* with a drive gear keyed to its outer end.

S. BLISS.

Another Taper Gage.

The sketch shows a taper gage which I made during my career as a machinist. It may possibly help some of the craft. It can be used for cross-head or valve-



ANOTHER TAPER GAGE.

stem keys. The gage is placed in the keyhole and set, the thumb-screw *E* binds it securely. The member *B* is threaded to receive the thumb-screw *E*.

C. A. HAAG.
Instructor Purdue University.

Getting Broken Taps Out—Starting an Obstinate Stud.

Referring to the communications on the above subject at pages 159 and 358, we can read there nice little suggestions which are worth good time and money both, for the men who are going to follow them.

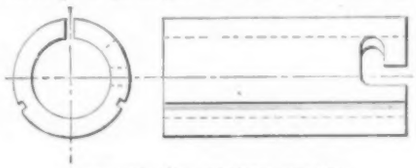
At page 358 we find, accompanied by an elaborate view of a broken stud, a description of how John Handy tried and studied for about an hour, "tapping lightly and hitting hard," to start that stud, and how he finally worked out a scheme by which, with the aid of another man, he removed the stud after another half hour's work.

If John Handy had simply picked up a gas burner or any small kerosene or gasolene burner and heated the piece in which the stud was stuck, in less than ten minutes he certainly could have withdrawn that stud as easily as if it had been a sliding fit.

A. L. P.

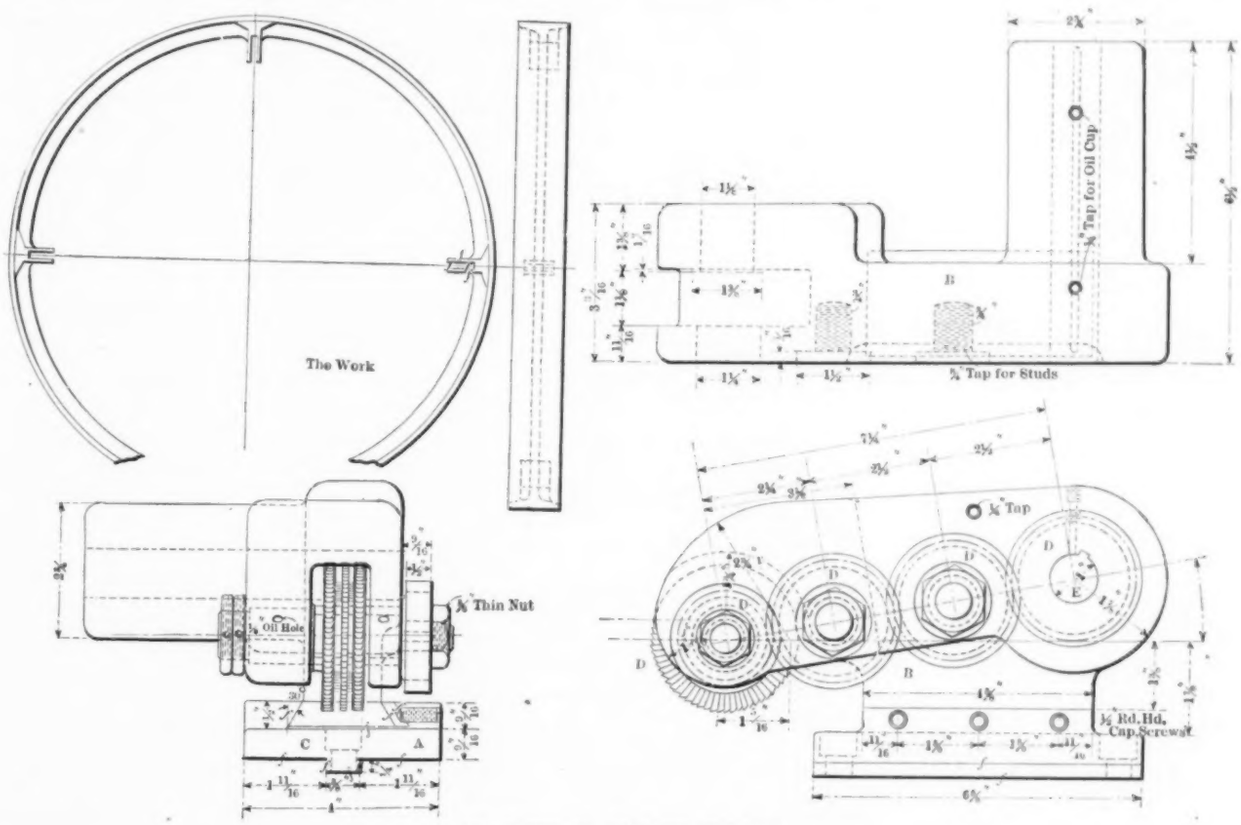
Bushings for Spring Collets.

Where spring chucks are used it often happens that a collet is wanted with an odd-size hole for some small lot of special work, and it will be found very handy to have a collet with a straight hole clear through it as large as the outside diameter



BUSHING FOR SPRING COLLET.

will allow, for taking bushings. We make these bushings like the sketch; they are of soft steel and case-hardened. A pin in the chuck holds the bushing flush with the outside of the collet, the bushing is pushed in and turned until the pin slips in the straight part of the slot, and then turned



AN INTERNAL MILLING FIXTURE.

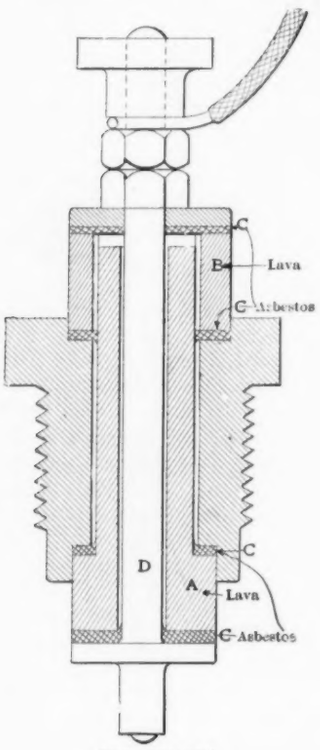
so as to bring the pin to the closed end of the slot. The slot being cut in the direction of the rotation of the work, the bushing is held in while the machine is running and can be easily removed with the fingers when the machine is stopped.

PAUL WESLEY.

A Remedy for "A Gas-Engine Trouble."

I offer the form of insulation shown in the illustration as a remedy for igniter troubles mentioned at page 124.

A is a lava bushing and *B* a lava collar. *C* are asbestos washers which are used to make a tight joint and not for insulation. The electrode *D* passes through the



THE REMEDY.

bushings, and is completely insulated at every point. When the nuts are screwed up the head of the bushing is drawn up and makes a tight joint while the body is free to expand and contract with the changes of temperature. If this form is adopted I do not think there will be trouble from defective insulation.

W. ALTON.

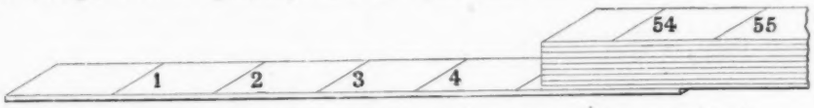
Perpetual Motion at Last.

Who can deny that the AMERICAN MACHINIST is a boon to us machinists? Acting on the idea suggested by the article on the above subject at page 327, I am getting out drawings for a much more powerful machine than that shown at page 327. The weights used by I. N. Ventor differ by only 3 lb. By using 116-lb. weights I find that they change to 911 lb., giving a difference of 795 lb. Will this give enough power to drive a small lathe?

DIXIE.

Rule Graduations.

There is a difference between the graduation of rules made for use in the United States and those made for foreign countries. I refer to the light spring-jointed pocket rules. Those graduated for the American trade are so arranged that for many purposes the figures must be read in their inverted position, and continual care is required to avoid errors from this cause, particularly the transposition of figures. The rules graduated for foreign trade are generally made so



RULE WITH FOREIGN STYLE OF GRADUATION (INCHES SUBDIVIDED TO 16THS).

that there is no necessity of working with the figures upside down, and therefore liability of error is lessened. The accompanying sketch explains the difference. Of course some will object that the rule is not intended to be read upside down, but theoretical ideas as to how a rule should be read occasionally do not work in practice, and I have found numberless cases where it was impossible to read the rule in any other way than upside down; for it was impossible for me to stand on my head while using it.

The advantages of a rule graduated as shown are: The lowest and most used graduations are protected when the rule is folded; it can be used flat on the work in confined places, avoiding the necessity of placing it edgewise or unfolding it its full length; and last but not least it is never necessary to stand on one's head to have the figures right side up. The first few rules of this kind owned by me were made in Germany, as shown by the sketch, and graduated in 16ths of an inch, but later importations were made in such a style that the low graduations come on the outside of the rule where they are rapidly destroyed; it is quite possible that this latter method of graduation may have been adopted to increase the sale of the rules.

A. D. WILLIAMS, JR.

A New Way to Bend Tubing.

Your paper having published a number of articles on the bending of tubes, I take it for granted that a new way would be of interest to your readers.

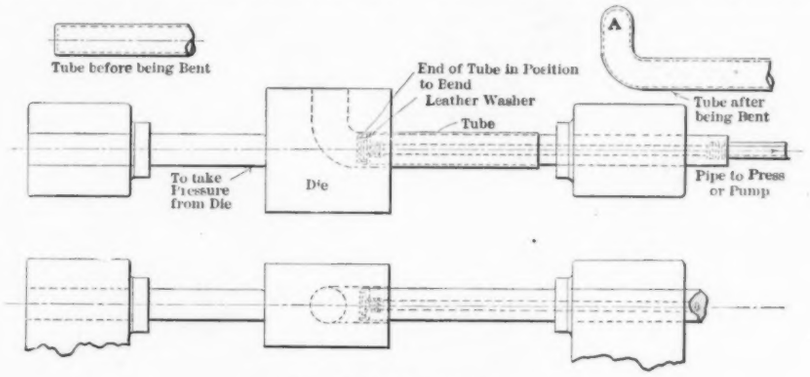
The principal trouble in bending a tube is the tendency to buckle and wrinkle, but this way we find no such trouble.

The tube I refer to is brass, 1¾ inches diameter, with about 1/16-inch wall, and had to be bent at an angle of 90 degrees without a wrinkle, crease or mark of any kind; it also had to be round and of an exact diameter.

In order to get a tube with these requirements we made a die, in halves, milled it out to the shape of bend wanted, hardened it and polished the cut very smooth.

The tube was laid in the lower half of the die with the end at the beginning of the curve; the upper half was then clamped in position, and a plunger pushed into the tube from the open end. Both the die and the piston now having a support to withstand the pressure, the pump was turned on and the water pressure (6000 lb. per sq. in.) besides keeping the tube round, pushed it around the curve in the die until it reached a required length.

The tube was then taken out, and the round end *A* (the result of the pressure) was cut off, and we had a tube as smooth and round as the form in the die. The die must be well supplied with grease, as the friction on the sides is very great.



A NEW WAY TO BEND TUBES.

The sketch shows the rig and the tube as it is before and after it is bent; with this as a help I think no further explanation is necessary.

Indiana. ARTEBE.

Photographing Blue-prints.

At page 384 you quote from the *Engineering Record* as to the desirability of changing blue-prints to some color which may be photographed, as, for instance,

green. I have found that prints changed to a purple photograph very well indeed, and this change may be easily accomplished by spraying the prints with ammonia by means of an atomizer. If carefully done the blue will change to a bright purple long enough to be photographed. then will gradually return to the original color. The same effect may be had by fuming the prints by means of a swab of absorbent cotton saturated with ammonia and waved in front of the print.

Use a "contrast" plate and develop with hydrochinon. W. H. SARGENT.

The Strength of Spur Gearing.

I enclose a diagram and tables of the working loads, etc., of cast and cut spur gearing, that I have found very useful in practice, and believe your readers also will so find them. F. W. SALMON.

The Honesty of the Japanese.

Reading in the AMERICAN MACHINIST about the honesty of the Japanese as a nation, and as I always like to give credit where it is due, I will give my experience after having spent two years among these people.

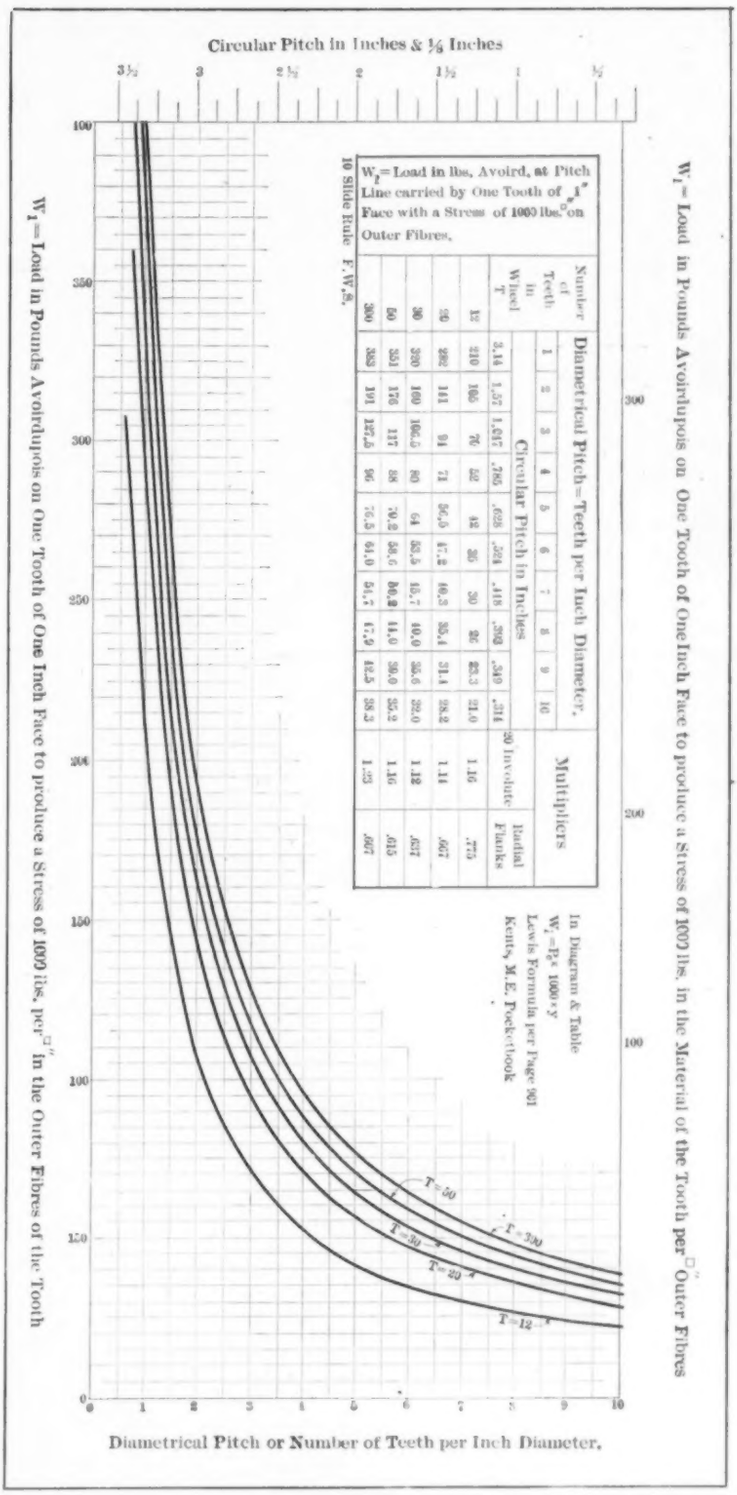
When I was leaving America I was told by some of the most prominent Japanese men in New York that I would find much dishonesty among the trades people and lower classes—but Government officials would always be found to be strictly honest.

I have found in all my dealings with this people that I have been treated courteously, kindly and honestly from the highest to lowest class—have had a number of articles returned to me that I had forgotten in stores or dropped in the street—such as canes, gloves and even my pocketbook. While there is some petty thieving and pocket-picking among themselves it rarely extends to foreigners.

The trades people will in nearly every case, when asked the price of their goods by foreigners, give a very high figure, but after one has learned the correct value of an article he can always buy at a great reduction. This is an old custom among themselves by which they spend much time bargaining or "haggling," over the price—while they smoke. But such customs are rapidly passing away and modern business methods are taking their place.

A friend having occasion to send a number of small packages by mail, went to the post office for the necessary stamps, and as he believed paid the correct amount, but in about three days a special messenger was sent by the clerk in the post office with 3 sen, which had been overpaid on the postage.

Frequently when I first came to this country and before I could understand exactly what was said when they gave me the price of an article, I would hold out a handful of change for them to take out the correct amount, and I invariably found


Circular Pitch in Inches & ⅛ Inches
3½ 3 2½ 2 1½ 1 ½
W₁ = Load in Pounds Avoirdupois on One Tooth of One Inch Face to produce a Stress of 1000 lbs. per □" in the Outer Fibres of the Tooth
W₁ = Load in Pounds Avoirdupois on One Inch Face to produce a Stress of 1000 lbs. in the Material of the Tooth per □" Outer Fibres
Diametrical Pitch or Number of Teeth per Inch Diameter.
T=50
T=30
T=20
T=12
W₂ = Load in lbs. Avoird. at Pitch Line carried by One Tooth of 1" Face with a Stress of 1000 lbs. □" on Outer Fibres.
10 Slide Rule F. W. S.
In Diagram & Table W₁ = P₂ × 1000 × y
Lewis Formula per Page 961 Kent's M. E. Pocketbook

Number of Teeth in Wheel T	Diametrical Pitch = Teeth per Inch Diameter. 1	2	3	4	5	6	7	8	9	10	Multipliers 20° Involute	Radial Flanks
	Circular Pitch in Inches 3.14	1.57	1.047	.785	.628	.524	.448	.393	.349	.314		
12	210	105	70	52	42	35	30	26	23.3	21.0	1.16	.775
15	262	131	87	65	52	43.6	37.4	32.7	29.0	26.2	1.14	.667
30	350	160	106.5	80	64	53.5	45.8	40.0	35.6	32.0	1.12	.617
50	353	176	117	88	70.2	58.6	50.3	44.0	39.0	35.2	1.10	.615
300	383	191	127.5	96	76.5	64.0	54.7	47.9	42.5	38.3	1.08	.607

Speed Co-efficients								
Feet per Minute at Pitch Line	100	400	800	1200	1700	2000	2400	3000
Co-efficient	1.00	.63	.42	.32	.25	.22	.20	.18

Allowable Stress in Materials at 100 Ft. per Minute.				
Material		Ult. Strength	Elastic Limit	Working Stress
Cast Iron	Cut	22000 lbs. □"		8000
	Rough			4000
Cast Steel		60000	28000	20000
Forged Steel		65000	31000	25000
Brass				16000

Gears with Cast Teeth (Iron Brass or Steel) should not carry over ⅓ Load of Cut Teeth.

THE STRENGTH OF SPUR GEARING.

that they had been honest with me to the rin piece—their smallest coin, of which it takes ten to make one sen, or about one-twentieth of a cent.

In some cases their honesty is a little annoying, for instance, when through reading a paper or book on the train you leave it on the seat as we would in America, someone, either conductor or passenger, is sure to call or run after you to return it, thinking you have forgotten it.

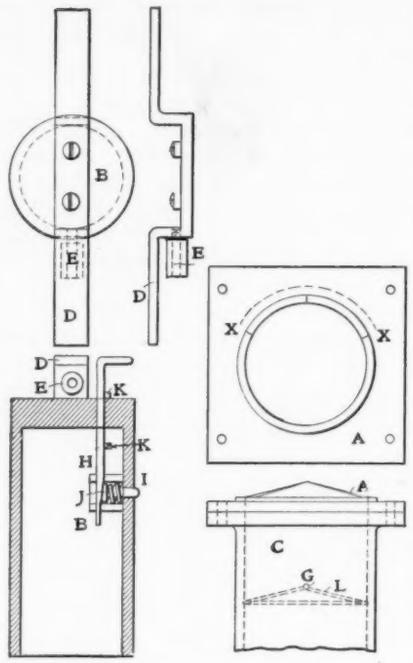
CHAS. A. FRANCIS.

Higher Technological School, Tokio.

Cutting Oil Grooves in Gas-engine Cylinders.

We cut oil grooves in gas-engine cylinders with the device shown in the illustrations. *C* is part of the gas-engine cylinder with the oil groove shown in dotted lines at *L*. *A* is a plate with four plugs in the corners which fit in holes in *C*. *A* has a cam on it reaching from *X* to *X*. *B* is the cutter head; it is made an easy-turning fit for the cylinder *C* and the hole in the center of the cam plate. *I* is the tool controlled by the wedge *H*. *D* is the handle fastened to the top of *B*. *D* is offset so as to clear the face of the cam *XX*. On the side of *D* is a roller *E*, which rests on the cam. The hole *G* is the oil hole in the cylinder *C*.

The tool is used in this way: The plate *A* is put on top of the cylinder *C*, as



CUTTING OIL GROOVES IN GAS ENGINE CYLINDERS.

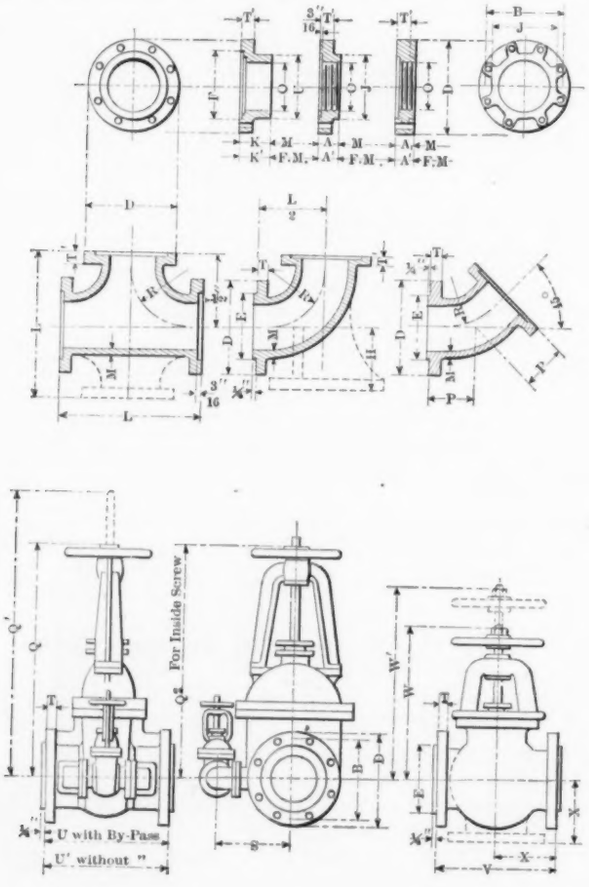
shown in the lower right-hand corner. The wedge *H* is lifted and the spring *J* forces the tool *I* back so that *B* can be inserted in the cylinder *C* and plate *A*. The roller *E* rests on the cam. *B* is turned till the tool *I* is opposite the hole *G*, the wedge *H* is then forced down till the upper stop *K* is in the position shown in the illustration. This forces the tool *I* to cutting-depth. The head *B* is then turned by the handles *D*, while at the same time it is forced down so that the roller *E* is in contact with the cam face. This device gives very satisfactory results.

WM. H. THIEMER.

Pipe-Fitting Standards.

During my many years' experience in the drafting room I found that there are many data that every draftsman must continually have before him. While many such data are contained in the various handbooks and catalogs, it is often in such shape that the draftsman loses much time in arriving at just the information he requires. I have therefore, arranged many data sheets for my own and my fellow-draftsman's use, these sheets being a part of our regular book of standards. One set of these sheets (or double sheets, as they are) was for pipe fittings, before arranging which it was necessary to look over several pages to get all the various dimensions of the numerous fittings and valves.

The object in getting up these sheets was to give all the dimensions of each fitting and valve for any one pressure on a single double sheet, thus making it



Size	Flanges										Bolts		Elbows & Tees		Gate Valves			G. & A. Valve		
O	D	B	E	F	C	J	T	T^1	A	A^1	No.	Dia.	L	R	U	U^1	Q	Q^1	Q^2	S	W	W^1	V	X
2	6	$3\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{4}$		$3\frac{1}{4}$	$\frac{7}{16}$	1	$1\frac{1}{4}$	$1\frac{3}{8}$	4	$\frac{5}{8}$	11		8	$8\frac{3}{4}$	12	$14\frac{3}{8}$			$11\frac{3}{8}$	$11\frac{7}{8}$	$9\frac{1}{4}$	$4\frac{7}{8}$
$2\frac{1}{2}$	7	$4\frac{1}{16}$	$\frac{5}{16}$	$\frac{3}{4}$		$3\frac{15}{16}$	$\frac{15}{16}$	$1\frac{1}{16}$	$1\frac{5}{16}$	$1\frac{7}{16}$	4	$\frac{5}{8}$	12		$8\frac{3}{4}$	$9\frac{3}{4}$	14	$16\frac{1}{8}$			$13\frac{1}{8}$	$13\frac{3}{8}$	$10\frac{1}{4}$	$5\frac{1}{4}$
3	8	$4\frac{7}{8}$	$\frac{5}{16}$	$\frac{7}{8}$		$4\frac{7}{8}$	1	$1\frac{1}{16}$	$1\frac{7}{16}$	$1\frac{9}{16}$	4	$\frac{5}{8}$	13		$9\frac{3}{4}$	$10\frac{3}{4}$	15	$17\frac{1}{2}$			$14\frac{3}{8}$	$14\frac{7}{8}$	$11\frac{1}{4}$	$5\frac{3}{4}$
$3\frac{1}{2}$	$8\frac{1}{2}$	$5\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$		$5\frac{1}{16}$	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{9}{16}$	$1\frac{11}{16}$	4	$\frac{5}{8}$	14		$10\frac{3}{4}$	$11\frac{3}{4}$	21	$23\frac{1}{8}$			$15\frac{3}{8}$	$15\frac{7}{8}$	$12\frac{1}{4}$	$6\frac{1}{4}$
4	9	$5\frac{1}{4}$	$\frac{5}{16}$	$\frac{7}{8}$		$5\frac{1}{4}$	$1\frac{1}{16}$	$1\frac{1}{4}$	$1\frac{11}{16}$	$1\frac{13}{16}$	8	$\frac{5}{8}$	$14\frac{1}{2}$		11	$11\frac{3}{4}$	$18\frac{15}{16}$	$20\frac{3}{4}$			$16\frac{3}{8}$	$16\frac{7}{8}$	$13\frac{1}{4}$	$6\frac{3}{4}$
$4\frac{1}{2}$	$9\frac{1}{2}$	$5\frac{7}{16}$	$\frac{5}{16}$	$\frac{7}{8}$		$5\frac{7}{16}$	$1\frac{1}{8}$	$1\frac{5}{16}$	$1\frac{13}{16}$	$1\frac{15}{16}$	8	$\frac{5}{8}$	16		$11\frac{3}{4}$	$12\frac{3}{4}$	21	$22\frac{3}{4}$			$17\frac{3}{8}$	$17\frac{7}{8}$	$14\frac{1}{4}$	$7\frac{1}{4}$
5	$10\frac{1}{2}$	$6\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$		$6\frac{1}{16}$	$1\frac{3}{16}$	$1\frac{3}{8}$	$1\frac{15}{16}$	$2\frac{1}{16}$	8	$\frac{5}{8}$	17		$12\frac{1}{4}$	$13\frac{1}{4}$	$24\frac{3}{8}$	$25\frac{3}{4}$			$18\frac{3}{8}$	$18\frac{7}{8}$	$15\frac{1}{4}$	$7\frac{3}{4}$
6	12	$7\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$		$7\frac{1}{16}$	$1\frac{5}{16}$	$1\frac{7}{16}$	$2\frac{1}{16}$	$2\frac{3}{16}$	8	$\frac{5}{8}$	18		$14\frac{1}{2}$	$15\frac{1}{2}$	$28\frac{1}{16}$	$29\frac{3}{4}$			$19\frac{3}{8}$	$19\frac{7}{8}$	$16\frac{1}{4}$	$8\frac{1}{4}$
7	$13\frac{1}{2}$	$8\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$7\frac{1}{4}$	$8\frac{1}{4}$	$1\frac{7}{16}$	$1\frac{9}{16}$	$2\frac{3}{16}$	$2\frac{5}{16}$	8	$\frac{5}{8}$	20		$15\frac{1}{2}$	$16\frac{1}{2}$	$30\frac{1}{16}$	$31\frac{3}{4}$			$20\frac{3}{8}$	$20\frac{7}{8}$	$17\frac{1}{4}$	$8\frac{3}{4}$
8	14	$9\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$8\frac{1}{4}$	$9\frac{1}{4}$	$1\frac{9}{16}$	$1\frac{11}{16}$	$2\frac{5}{16}$	$2\frac{7}{16}$	8	$\frac{5}{8}$	21		$16\frac{1}{2}$	$17\frac{1}{2}$	$31\frac{7}{16}$	$33\frac{3}{4}$			$21\frac{3}{8}$	$21\frac{7}{8}$	$18\frac{1}{4}$	$9\frac{1}{4}$
9	$15\frac{1}{2}$	$10\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$9\frac{1}{4}$	$10\frac{1}{4}$	$1\frac{11}{16}$	$1\frac{13}{16}$	$2\frac{7}{16}$	$2\frac{9}{16}$	8	$\frac{5}{8}$	23		$17\frac{1}{2}$	$18\frac{1}{2}$	$32\frac{13}{16}$	$35\frac{3}{4}$			$22\frac{3}{8}$	$22\frac{7}{8}$	$19\frac{1}{4}$	$9\frac{3}{4}$
10	$16\frac{1}{2}$	$11\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$10\frac{1}{4}$	$11\frac{1}{4}$	$1\frac{13}{16}$	$1\frac{15}{16}$	$2\frac{9}{16}$	$2\frac{11}{16}$	12	$\frac{5}{8}$	24		$18\frac{1}{2}$	$19\frac{1}{2}$	$34\frac{7}{16}$	$37\frac{3}{4}$			$23\frac{3}{8}$	$23\frac{7}{8}$	$20\frac{1}{4}$	$10\frac{1}{4}$
12	19	$13\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$12\frac{1}{4}$	$13\frac{1}{4}$	$2\frac{1}{16}$	$2\frac{3}{16}$	$2\frac{13}{16}$	$2\frac{15}{16}$	12	$\frac{5}{8}$	26		$20\frac{1}{2}$	$21\frac{1}{2}$	$38\frac{7}{16}$	$41\frac{3}{4}$			$25\frac{3}{8}$	$25\frac{7}{8}$	$22\frac{1}{4}$	$11\frac{1}{4}$
14	$21\frac{1}{2}$	$14\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$13\frac{1}{4}$	$14\frac{1}{4}$	$2\frac{3}{16}$	$2\frac{5}{16}$	$3\frac{1}{16}$	$3\frac{3}{16}$	12	$\frac{5}{8}$	29		$23\frac{1}{2}$	$24\frac{1}{2}$	$42\frac{1}{16}$	$45\frac{3}{4}$			$28\frac{3}{8}$	$28\frac{7}{8}$	$25\frac{1}{4}$	$12\frac{3}{4}$
15	$22\frac{1}{2}$	$14\frac{11}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$13\frac{3}{4}$	$14\frac{3}{4}$	$2\frac{5}{16}$	$2\frac{7}{16}$	$3\frac{3}{16}$	$3\frac{5}{16}$	12	$\frac{5}{8}$	30		$24\frac{1}{2}$	$25\frac{1}{2}$	$43\frac{11}{16}$	$47\frac{3}{4}$			$29\frac{3}{8}$	$29\frac{7}{8}$	$26\frac{1}{4}$	$13\frac{1}{4}$
16	$23\frac{1}{2}$	$15\frac{5}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$14\frac{1}{4}$	$15\frac{1}{4}$	$2\frac{7}{16}$	$2\frac{9}{16}$	$3\frac{5}{16}$	$3\frac{7}{16}$	16	$\frac{5}{8}$	31		$25\frac{1}{2}$	$26\frac{1}{2}$	$45\frac{5}{16}$	$49\frac{3}{4}$			$30\frac{3}{8}$	$30\frac{7}{8}$	$27\frac{1}{4}$	$13\frac{3}{4}$
18	$25\frac{1}{2}$	$16\frac{9}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$15\frac{1}{4}$	$16\frac{1}{4}$	$2\frac{9}{16}$	$2\frac{11}{16}$	$3\frac{7}{16}$	$3\frac{9}{16}$	16	$\frac{5}{8}$	33		$27\frac{1}{2}$	$28\frac{1}{2}$	$48\frac{13}{16}$	$53\frac{3}{4}$			$32\frac{3}{8}$	$32\frac{7}{8}$	$29\frac{1}{4}$	$14\frac{3}{4}$
20	$27\frac{1}{2}$	$17\frac{13}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$16\frac{1}{4}$	$17\frac{1}{4}$	$2\frac{11}{16}$	$2\frac{13}{16}$	$3\frac{9}{16}$	$3\frac{11}{16}$	20	$\frac{5}{8}$	36		$29\frac{1}{2}$	$30\frac{1}{2}$	$52\frac{3}{16}$	$57\frac{3}{4}$			$34\frac{3}{8}$	$34\frac{7}{8}$	$31\frac{1}{4}$	$15\frac{3}{4}$
22	$29\frac{1}{2}$	$19\frac{1}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$17\frac{1}{4}$	$18\frac{1}{4}$	$2\frac{13}{16}$	$2\frac{15}{16}$	$3\frac{11}{16}$	$3\frac{13}{16}$	20	$\frac{5}{8}$	38		$31\frac{1}{2}$	$32\frac{1}{2}$	$55\frac{9}{16}$	$61\frac{3}{4}$			$36\frac{3}{8}$	$36\frac{7}{8}$	$33\frac{1}{4}$	$16\frac{3}{4}$
24	$31\frac{1}{2}$	$20\frac{7}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	$18\frac{1}{4}$	$19\frac{1}{4}$	$2\frac{15}{16}$	$3\frac{1}{16}$	$3\frac{13}{16}$	$3\frac{15}{16}$	20	$\frac{5}{8}$	40		$33\frac{1}{2}$	$34\frac{1}{2}$	$58\frac{15}{16}$	$65\frac{3}{4}$			$38\frac{3}{8}$	$38\frac{7}{8}$	$35\frac{1}{4}$	$17\frac{3}{4}$

PIPE-FITTING STANDARDS.

necessary to have only one sheet for each pressure for which standards were required.

The accompanying sheet is for 150-pound fittings and valves, and it will be seen that the whole thing is gotten into a very small space and is quite convenient to use.

The flanges are made both male and female, the unprimed letters referring to the male and the primed letters to the female flanges. J. I. BLOUNT.

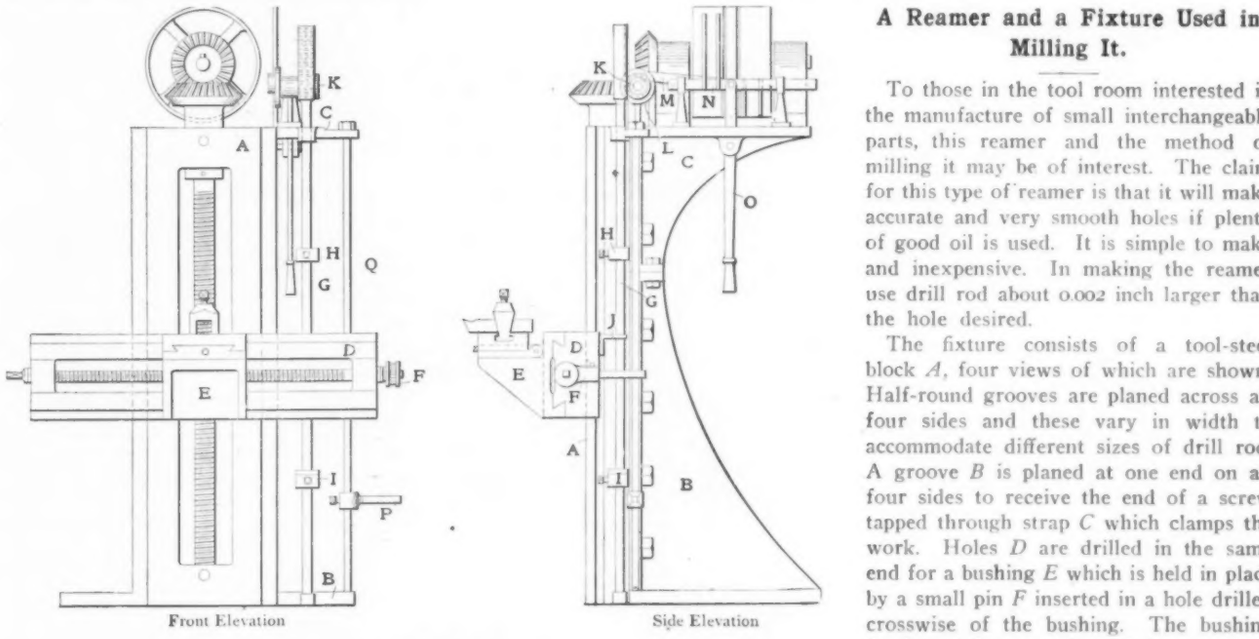
A Portable Upright Planing Machine.

The sketch shows an upright planer with maximum stroke of 7 feet 6 inches which we designed for operating on large cast-iron pipe flanges, cylinder ends, etc. It is of the portable type, and can be moved about on a large floor plate to any convenient position where the driving belts can work, and where the machine can be securely bolted down. It is quite rigid and a cut 5/8 inch deep with 1/16 inch feed can be taken without any fear of damaging the machine.

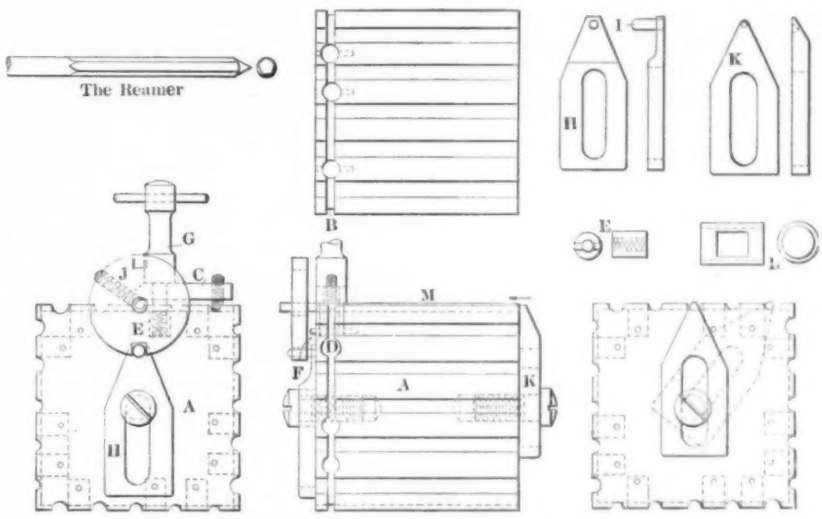
A is the front member planed back and front, with a tongue fitting into a groove in *B* and *C*, which parts are similar to ribbed angle plates, and bolted to *A* by a row of studs and nuts down each side as shown in the side elevation; *B* and *C* are also bolted together where they meet, to give additional rigidity. The cross rail *D* is driven by a screw 3 inches in diameter and carries the traversing saddle *E*, which in turn carries the tool box. The ratchet feed for the saddle is shown at *F*. *G* is an upright rod 1 inch diameter, with two adjustable dogs *H* and *I*, the latter carrying a loose layer of rubber 1/2 inch thick to prevent chattering when reversing. *J* is a steel bracket bolted to *D*, which operates the shifting gear (supported on the brackets at the top of the upright) through the rack which the rod *G* terminates in. This rack meshes with the pinion *K*, keyed on the same shaft as the disk *L*, carrying the crank pin for the connecting rod *M*, which, through shifter *N* and the belt forks, controls the crossed and straight belts. The two outside pulleys are 6 1/2 inches face, while the fast pulley in the center is 3 1/4 inches wide for a 3-inch belt. *O* is the handle for stopping and starting the machine or reversing the stroke, at any time. *P* is an adjustable arm carried on the rod *Q*, for operating the feed ratchet *F*, when it is at the point of reversing, as the tool cuts on the up stroke.

The driving screw receives its motion from the bevel wheels on top, as shown. It has a double thread of 2 inches lead and makes 140 turns per minute when cutting, which gives a speed of 23 feet per minute; on the return stroke the screw runs at 190 turns, giving a speed of 31 feet per minute. This is of course accomplished by having the driving pulleys on the line shaft of different diameters. The machine has done a large variety of work since we made it and we find it profitable to keep it in daily use, as it requires very little attention.

H——, England. SOEZE.



A PORTABLE UPRIGHT PLANER.



A MILLING FIXTURE FOR SMALL REAMERS.

A Reamer and a Fixture Used in Milling It.

To those in the tool room interested in the manufacture of small interchangeable parts, this reamer and the method of milling it may be of interest. The claim for this type of reamer is that it will make accurate and very smooth holes if plenty of good oil is used. It is simple to make and inexpensive. In making the reamer use drill rod about 0.002 inch larger than the hole desired.

The fixture consists of a tool-steel block *A*, four views of which are shown. Half-round grooves are planed across all four sides and these vary in width to accommodate different sizes of drill rod. A groove *B* is planed at one end on all four sides to receive the end of a screw tapped through strap *C* which clamps the work. Holes *D* are drilled in the same end for a bushing *E* which is held in place by a small pin *F* inserted in a hole drilled crosswise of the bushing. The bushing is threaded to receive binder screw *G* which passes through clamp *C* and holds the reamer in position while the cut is being taken. Piece *H* has an elongated slot and a pin *I* which fits into notches of index plate *J*. *K* is a similar piece with an elongated slot having a small female center close to the top. *H* and *K* are held in position by fillister-head screws. The screw in the index plate is tightened against the reamer shank through bushing *L* and dogs it around to the different cuts. A number of index plates can be

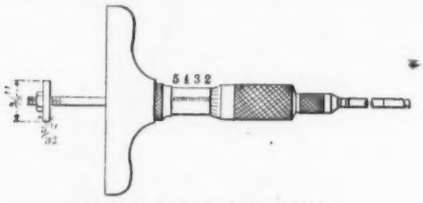
made with any number of notches wanted.

Bushings like *L* are made to accommodate the different sizes of drill rod used; the bush fills the center hole of index plate *J* and is cut through at one side to allow the screw in the plate to pass through and bear against the shank of the reamer. In the side view of the fixture the reamer is shown in position at *M*. After the milling cut is taken in the direction of the arrow the clamping screw *G* is loosened and the work and index plate are slightly drawn out so that the notch in the plate is disengaged from pin *I*. The plate is now turned to the next notch and pushed back with the work in position, the point of the reamer entering the female center in *K* which holds it firmly down on the bottom of the groove in the fixture. The clamp screw *G* is now tightened and the job is ready for another cut. This procedure is repeated until the reamer is finished.

The grooves on the four sides of the fixture vary in size as already stated. The first side will accommodate drill rod Nos. 47 to 60; second side Nos. 20 to 28; third side Nos. 30 to 38, and the fourth side Nos. 40 to 46. Piece *H*, index plate *J* and female center *K* can be easily placed in position for any of the grooves. The fixture was designed to be used on a hand milling machine and it paid for itself in a short time. The grooves solidly support the work under the cutter and therefore the job produced is much better than if milled in the usual way. E. W. NORTON.

Depth-Gage Attachment.

The sketch shows a Brown & Sharpe tool with an attachment added by myself. The tool is their micrometer depth gage and the attachment converts it into an outside micrometer. For measuring in places where it is impossible to use the regular micrometer or where the work cannot ordinarily be measured while in



DEPTH-GAGE ATTACHMENT.

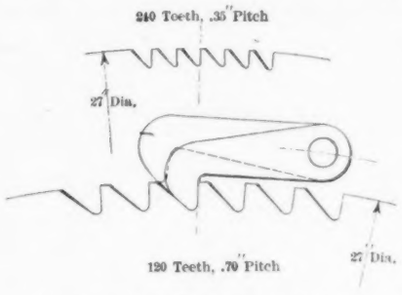
the lathe and for measuring through openings etc., it is one of the handiest tools a machinist can have. I made a temporary one for trial and now B. & S. are making me a graduated rod (for $1) to be adjusted by myself. The rod is longer than the original by the threaded portion at the end. Any machinist having the gage will find the extra rod indispensable when he once possesses it. The range covered is 2½ inches by thousandths from 0. The disk is ⅜x3/32 inch, hardened and ground; when adjusted it is held in position by a lock nut as the sketch shows.

MACHINIST.

Double Pawl for Fine Spacing.

As the subject of ratchets is receiving quite a lot of mention of late I send the sketch herewith.

It is not new or original but is intended for those who have not come across it as yet. An illustration of its use came to my notice some time ago. We had a cylinder which had a flange 27 inches



DOUBLE PAWL FOR FINE SPACING.

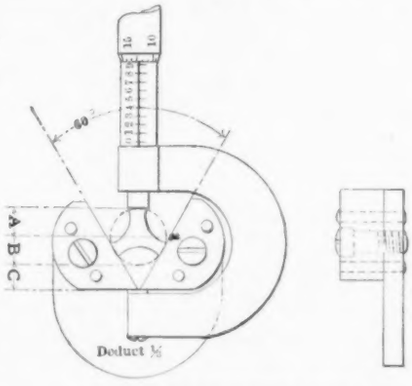
diameter by one inch thick. It was desired to rotate the cylinder by a pawl and ratchet movement 1½ degrees at a time. By using a single pawl it would require 240 teeth, which would allow only 0.35 inch pitch, which was not strong enough for the work to be done, therefore the double pawl was used, which allowed 120 teeth with a pitch of 0.70 inches. It will be seen from the sketch that one pawl is longer than the other, the difference in length being one half the pitch of the teeth. The movement of the pawls is the same in either case, but the double pawls take hold of the teeth alternately.

C. E. J.

Measuring Three-Fluted Tools.

The enclosed sketch shows a V-block or gage for measuring three-fluted drills, counterbores, etc.

The angle being 60 degrees, the distances *A*, *B* and *C* are equal. Consequently to determine the correct diam-



MEASURING THREE-FLUTED TOOLS.

eter of the piece to be measured, apply the gage as indicated in the sketch and deduct one-third of the total measurement.

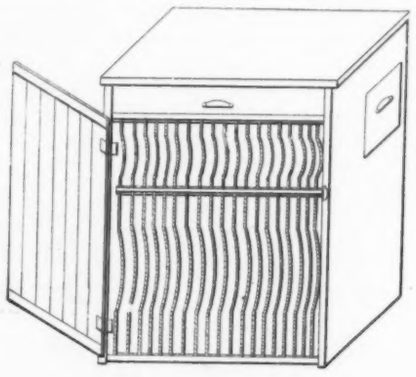
The use of this gage has a decided advantage over the old way of soldering on a piece of metal opposite a tooth (many a valuable piece of work being lost on account of drawing the temper, either through carelessness, ignorance or "hard luck"), or boring out a ring to fit to; not only on account of rapidity in operating, but in connection with this gage the micrometer becomes more delicate, errors showing one-third greater than they actually are.

Using a Pratt & Whitney standard 60-degree triangle for setting and a few different sizes of standard cylindrical plug gages for testing, the V-block was easily and very accurately made.

F. O. HOAGLAND.

An Emery-Wheel Cabinet.

About two years ago we established a grinding department in our shop, and after a few months the matter of what to do with our wheels as they accumulated became a problem, so I designed the accompanying wheel closet. The upper draw is 2½ inches deep and contains all wheels for internal work. The upper row inside is for 6- and 7-inch wheels for sur-



AN EMERY-WHEEL CABINET.

face grinders; a partition is placed in the rear of this compartment and a draw fitted in the side to utilize the remaining space. The lower row is for 12-inch wheels for universal grinders; an inch is allowed in depth and hight for clearance. The partitions are ½ inch thick, ⅝ inch apart for ½-inch wheels and cut out so that easy access may be had to any of the wheels. The bottom is sawed about ½ inch lower at the back, so that the closet will tilt slightly backward to prevent the wheels from rolling out.

LEWIS L. LEIGH.

Repairing Cracked Water Jackets.

At page 357 W. D. Graves gives some interesting information about repairing cracked water jackets. I had quite a few to do several years ago while working in a gas-engine factory. My great advantage was because all the cylinders were brought to the shop. First, a strip was made about 3/16 thick and 1½ inches wide, to completely cover the crack, following it wherever it went. This sometimes required nice blacksmith work. The

patch was then clamped over the crack and the whole put under a drill; ¼-inch holes about half an inch apart were drilled as nearly as possible along each side right into the jacket. The patch was removed and while the holes in the cylinder were being tapped, those in the strip were enlarged and countersunk. The strip was then riveted on and hot water with a liberal supply of brine was applied inside at 100 pounds pressure for three or four hours. We never had any complaints from the owners of engines repaired in this way. W. L. McL.

Canada.

Another Hook Tool.

The hook tool illustrated at page 226 reminds me of those used in Scotland twenty odd years ago. They were not called *hook* tools but *heel* tools, I suppose

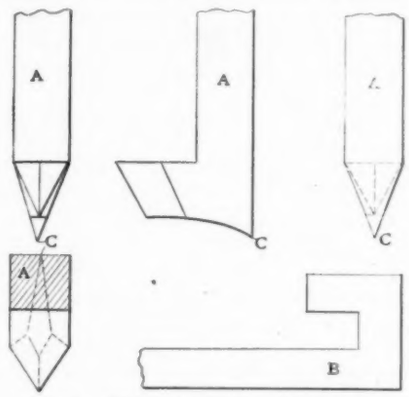


FIG. 1. HEEL TOOL AND CONTROLLER.

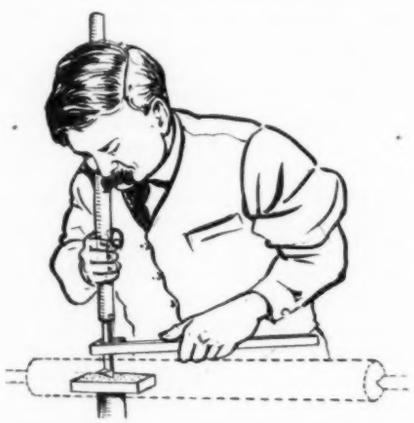


FIG. 2. USING THE HEEL TOOL.

because of the little sharp-pointed heel *C* that rests in center-punch marks on the rest. In the hands of an experienced operator they could be made to do wonders, but they had a most unpleasant way of showing their lack of respect for persons when in the hands of the uninitiated. When the tool digs, through unskilful manipulation, the long wooden handle thumps the dilettante operator vigorously in the jaw. Wierd tales are told of amateurs having been lifted clear over the shears of the lathe by this innocent-looking tool. Where I worked they were used for all kinds of small work where no great amount of accuracy was required, such as washers, finishing and chamfering the ends of nuts, etc. Fig. 1 shows the heel tool *A* and the hook-shaped piece of steel *B* held in the left hand to control it. The tool was usually made of ½ or ⅝ inch square steel, as was also the controller, if I may call it that, its correct name (if it ever had one) I have forgotten. The tool was driven into a round hard-wood handle about 2 inches diameter by 24 inches long. The controller was about 18 inches long and without a handle.

As I have said, this tool in the hands of an expert, gives excellent results, but the road to perfection is long, tortuous, and full of jolts. The dangers and snares for the unwary, that lurk by the wayside, are so many that I have often thought the price I paid for even moderate skill was altogether too high. Fig. 2 shows the correct position for the tool and the operator. We are supposed to be standing at the back of the lathe looking at the tool and man through an imaginary job shown by dotted lines between the centers. DIXIE.

Calculation of the Strength of a Crane Drum by Graphical Construction.

The accompanying sketch is a plan of an ordinary hoist drum, and illustrates a simple graphical method of determining the two bearing reactions at *C* and *B*, and the tooth pressure on the gear at *D*, the load applied at *A* being known, as well as the dimensions of the drum.

Let P = gear-tooth pressure at D.
W = load, applied at A.
R_B = bearing reaction at B.
R_C = bearing reaction at C.
R = resultant of W and R_B, and of P and R_C

The drum and gear are in equilibrium under the action of the four vertical forces P, W, R_B, and R_C, and hence the resultant of any two of these forces must be equal and opposite in direction to the resultant of the other two, and must be in the same vertical line.

Connect points *A* and *B* and points *C* and *D* by straight lines. Then the resultant of forces W and R_B must lie in the plane of those two forces—that is, must be projected as a point in the line *A B*. Also the resultant of P and R_C must lie in the plane of those forces and be projected in line *C D*. Since these two resultants are equal and lie in the same vertical straight line, their position is determined by the point of intersection of lines *AB* and *CD*, at *R*, and we have,

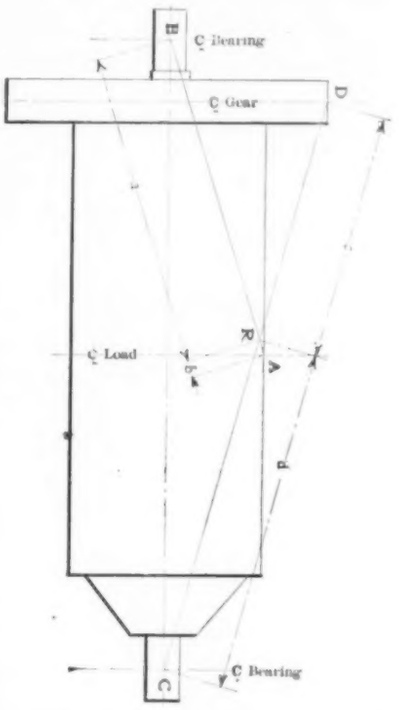
$$R = W\,\frac{a+b}{a}$$

$$R_B = W\,\frac{b}{a}$$

$$P = R\,\frac{d}{d+c} = W\,\frac{a+b}{a}\times\frac{d}{d+c}$$

$$R_C = R\,\frac{c}{d+c} = W\,\frac{a+b}{a}\times\frac{c}{d+c}$$

It will be noticed that as the resultant *R* lies between *A* and *B*, the direction of R_B is the same as that of W, that is, downward. This downward force at *B*, added to the bearing reaction at *B*, due to the weight of the drum, which is a vertically upward force, will show whether the journal presses against the lower or



PLAN OF A CRANE DRUM, SHOWING GRAPHICAL METHOD OF FINDING POSITION OF RESULTANT FORCE.

upper half of the bearing. The reaction R_C, as figured above, must also be increased by the addition of the component of the drum weight acting at *C*, to get the total amount of the reaction at that point.

The section of the drum at *A* must be designed for combined bending and twisting stresses in the usual way, the bending moment at *A* being taken as the product of the reaction R_C and the distance between center lines of R_C and W, and the twisting moment being taken as the product of P and the gear radius.

A. L. WESTCOTT.

Another Method of Case-Hardening.

Having a number of pins to case-harden recently, we were about to proceed in the usual way by heating a pot of cyanide of potash, when a different method was suggested by the boss nickel-plater.

Following his idea, we made a saturated solution of cyanide of potassium, first heating the water to make sure it would absorb as much cyanide as possible.

After allowing the solution to cool, we heated the pins to the usual heat and dipped them in the solution; then reheated them to a good red and plunged them into cold water.

To our surprise we found the pins,

which were about 3/16 inch diameter, were so hard that we were unable to use them, having the appearance of being hardened clear through. Trying a second lot, and reheating to a lower heat before plunging into cold water, we found them very satisfactory.

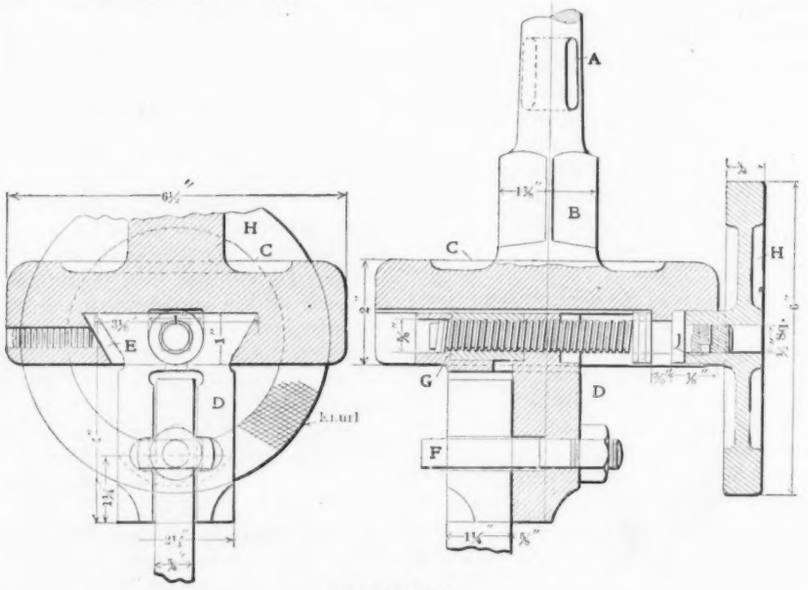
This method may not be new to everybody, but I have never seen it tried in our neck-of-the-woods before; and it is ever so much handier and cheaper than having a hot cyanide bath to maintain.

We found that a pound or a trifle more to each gallon of water made a good solution, and while I have not had as much opportunity to experiment as I could wish with this method, I have been able to harden faster and deeper than with the conventional cyanide bath. TNECNIV.

A Boring Tool.

The accompanying sketch illustrates an excellent boring tool which can be used in either the vertical milling machine or drill. It has also been used in the lathe and horizontal mill to great advantage.

The end of a tool shank is a No. 4 Morse taper, this taper is locked to the machine spindle by means of a key through the hole *A*, at *B* the shank is milled a square 1 3/8 inches across the flats to accommodate a wrench, the shank and head *C* are made in one piece of soft steel. The tool holder *D* is also made of soft steel fitted into the head *C* on a 60-degree dovetail and held to a good sliding fit by means of the hard brass gib *E*, which is locked by three 3/8-inch headless set-screws. The tool holder is slotted slightly wider than the tool, which is 3/4 x1 1/4-inch tool steel, held in place by the special yoke *F*. The top of the tool holder *D* is machined to receive the brass feed-screw nut *G*; the feed screw is 5/8 inch diameter and has eight square threads per inch. The screw is operated by the gray-iron hand wheel *H*, the hub of which has a 1/2-inch square hole fitting over the end of the screw and held in place by the spring lock *J*. If the wheel strikes the work it is taken off after the tool is set. Both sides and the face of the rim of the wheel are nurled to give a good hand grip. BAYARD.



A BORING TOOL.

Alameda, Cal.

The Strength of Rings.

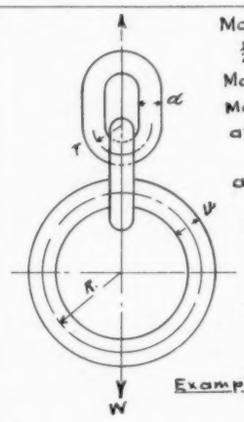
I send herewith a duplicate card from my card index or data box which gives some information on the strength of rings. The mathematics of this subject has been pretty well threshed over in the periodical referred to and the formulas have been developed in several well known text-books but so far as I know, such data have not yet found their way into the so called pocket books.

Data of a certain kind are not hard to find; all one has to do is to take a pair of calipers into the shop, measuring such chains, rings and shackles as are in common use. This will give a fair average of safe values, but it is hoped that some correspondent who has data of the failure of such rings will submit them, as such matter is of much more value than a long mathematical analysis.

JAMES A. BROWN.

RING.

STRENGTH OF WROUGHT IRON RINGS.



Max bending moment at crown
$\frac{1}{2}W(1-.3634)R = .318WR$
Max. M at side $=\frac{1}{2}W(.3634R) = .182WR$
Max fiber stress for circular section
at crown $\left(\frac{W}{D^2}\right)\left(\frac{3.238R}{D}\right)$
at side $\left(\frac{W}{D^2}\right)\left(\frac{.1896R}{D}+.6366\right)$
Ratio of stresses, crown to side.
D=1, R=1, Ratio 1.28
D=1, R=2, " 1.46
D=1, R=3, " 1.54

For Crane Chains etc.
$D=\sqrt[3]{\frac{Rd^3}{r}}$

Example, Boom or Rattling Chain
Newhall Chain F&I Co
$d=\frac{7}{8}$, r=1., R=3, D=1⅛
By formula $D=\sqrt[3]{\frac{3\times.667}{1}}=1.26$

References
Engineering - 1894
355, 428, 459, 489
494, 526,
1895 - pp. 418
Structural Mechanics
Green - pp 236

53-0

Reading the American Machinist.

The articles which have so far appeared at page 223 and elsewhere relating to the reading of the AMERICAN MACHINIST have been interesting and helpful to me, especially so for the reason that I have been trying to systematize my reading so that the entire contents will be carefully and thoughtfully read during the week at the times most convenient. My work is also in the drawing room, but I doubt very much if the reading of the paper from beginning to end during working hours would be tolerated, even though it may pertain to our particular class of work. To read one issue carefully will take at least three hours. A drawing-room force of ten men, all spending three hours, or one-third of the day, reading a paper, would not give the management a favorable impression of that department. There may be some places where the privilege would be cheerfully granted, as being a source of instruction to the men, thus making them more capable in their work; but I believe there are not many of our American shops that would allow it. The prevailing opinion seems to be that the men should improve their minds outside of working hours. I couldn't imagine a workman being allowed to spend say a half hour each day during working hours on a correspondence course, and I believe that reading the AMERICAN MACHINIST would be viwed in the same light. I know that in our plant it is not countenanced, although there is no objection to the draftsman spending a few minutes glancing through the paper and noting the general trend of the issue, but this privilege must not be abused. My reading is done almost wholly outside of working hours. The shorter articles I read during the noon hour. These include the letters to

the editor, the editorial page, the new tools described and illustrated near the end, and, in fact, any short paragraph which can be read carefully in a short time.

The book reviews I find very interesting and make notes of those which I think may be useful to me. When I desire to add a book on a particular subject to my technical library, I go over these notes, and my book catalogs, so that I may find the one which I think will best fill my requirements. I keep a notebook in which I enter notes of the book reviews properly classified. For instance, a number of pages are headed "Machine Design," others "Mechanical Drawing," and so on. The books which I have procured through these reviews were only those which had the AMERICAN MACHINIST's highest indorsement, and as yet I have never been disappointed.

The "new catalog" column also receives attention, and I send for those in which I am specially interested. The "situations wanted" and "help wanted" I always read and compare the two. I believe that such a comparison is a fair guide to the demand for good men. The number of draftsmen wanting work are checked against the number of positions vacant. The requirements and experience of each are also compared. I find this practice very diverting and instructive. All of the above I go over during the week at the noon hour. The longer and more comprehensive articles I reserve until some off evening or Sunday. These more complex or technical articles I read twice and find that I often learn nearly as much from the second reading as the first. It is during the evenings that all formulas and tables likely to be useful to me in the future are copied and placed for reference in an indexed data book. This book is of the loose-leaf style.

Any article which is of *very* special interest to me I try to re-write after the second reading, making the necessary (free hand) sketches and stating the text from memory. After this is written I again go over the article to see if anything important has been omitted or an incorrect conception formed, and if so, these additions or corrections are also made from memory.

The advertisements are not forgotten, and anything new or striking is carefully studied. I believe that I have received an impression of current American tool design which is of value to me by noting the illustrations and descriptions in catalogs and advertisements. But of course the advertisements do not receive as much attention as I give to the text.

When the current number of the paper is received, before looking at it, I take up the preceding issue and glance through to see if anything has been overlooked. If so, it is read before the following issue is opened.

I hope that we will hear from others of your readers on the subject, as it is most interesting to me, and I feel that so much more benefit can be derived from reading slowly and systematically than by a hasty perusal or with intermittent enthusiasm.

L. A. D.

Cutting Steep Pitch Worms on the Speed Lathe.

As we had only a few of these steep pitch worms to cut, the attachment was made as cheaply as possible. Fig. 1 illustrates the attachment complete in working position. The work to be cut is held in the brass coupling *A*, which is provided with a large rim to allow dividing, in case worms of more than one thread are to be cut. The front part of the attachment is fastened with the cap-screw *B* to the part *C*, which permits it to be swung to any desired angle. Part *C* is secured in the tool post. The feed toward the cutter is done by the cross-feed of the slide rest. The work to be cut is rotated by turning the dog in the opposite direction to that in which the cutter is running. Fig. 2 shows the attachment as seen from the front of the lathe, giving an idea of its position when in operation. A detailed description is hardly necessary, as the sketch shows the construction clearly. The feed screw *D* in Fig. 1, governs the pitch of the worm.

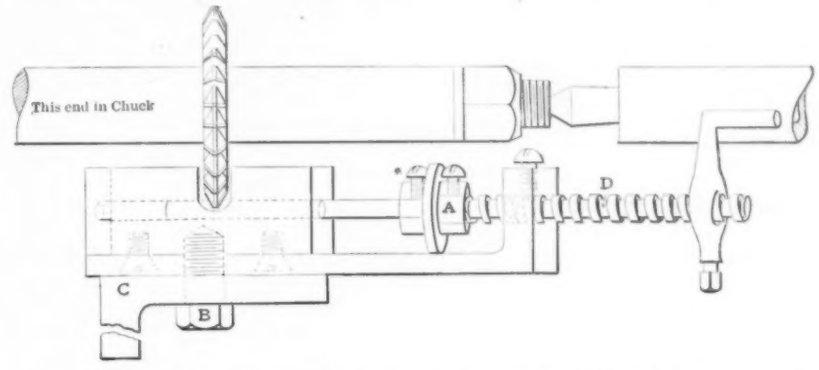


FIG 1. ATTACHMENT FOR MILLING WORMS IN THE SPEED LATHE.

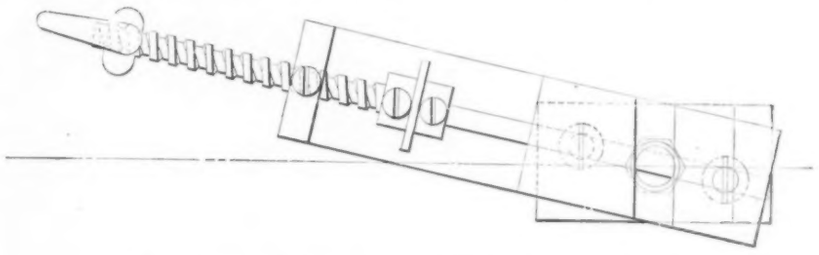


FIG 2. THE ATTACHMENT FROM THE BACK OF THE LATHE.

The cutter in the sketch is rather exaggerated. I have used slitting saws of Stubs steel with good results. To polish the worm replace the cutter with a copper disk charged with emery and oil and proceed as before. To obtain a brilliant polish, after polishing or roughing with emery replace the copper disk with a boxwood disk and charge it with diamantine and oil; the effect will be astonishing. Diamantine is obtainable at almost all watchmakers' supply stores.

In my experience this is an economical way of manufacturing small worms, as they are not apt to break as would be the case if without a rigid support.

ARTHUR F. MULLER.

Information Wanted on the Molding of Automobile-Cylinder Castings.

One of our correspondents has expressed a desire for a detailed description of the manner of molding a water-jacketed automobile cylinder, made with an automatic inlet valve above the exhaust valve. We should be pleased to receive from someone familiar with this line of work illustrations and descriptions, including discussion of the best way to prepare the cores, arrangement of parting lines, assembling the mold, venting, pouring, etc.

A contributor would like to have information regarding a method of soldering or brazing brass without the use of heat. He says that he understands this is done, but does not know how. Can any of our readers enlighten him?

One of our foundrymen readers would like to know if there is a foundry using crude oil in the cupola for melting iron, and if so, what is the proper arrangement of the burners as to their location, etc.

The Baldwin Locomotive Works has presented to the city of Philadelphia a statue of the founder of the works, Matthias Baldwin. The statue will be erected in Fairmount Park.

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Contents.

	PAGE
The College Shop	499
Power Transmitted by Worm Gearing	505
The Works and Methods of Alfred Herbert, Ltd., Coventry, England—II	506
The Best Machine Tools Made in Canada	509
Exposition Visitors—Motor Skates	510
Letters to the Editor: Thrust Bearing and Jump-Spark Commutator for Small Marine Two-Stroke Cycle Gasolene Engine....A Taper Gage....Diagram for Brake-Strap Calculations....A Proposed Apprenticeship System....A Collection of Comments....Another Thing that is Usually Wrong....An Internal Milling Fixture....Another Taper Gage....Getting Broken Taps Out—Starting an Obstinate Stud....Bushings for Spring Collets....A Remedy for "A Gas-Engine Trouble"....Perpetual Motion at Last....Rule Graduations....A New Way to Bend Tubing....Photographing Blue-Prints....The Strength of Spur Gearing....The Honesty of the Japanese....Cutting Oil Grooves in Gas-Engine Cylinders ....Information Wanted on the Molding of Automobile Cylinder Bearings	510—521
The Work of the College Shop	522
New Publications	522
New Tools and Machine Shop Appliances	524
Balancing at High Speed	526
An Instantaneous Positive Speed Variator	527
Some Remarkable Grinding Chips	528
Fireproof Flooring Made from Wood	528
Personal	529
Obituary	529

The Work of the College Shop.

We present in another column of this issue an important article by Professor Kimball, of Sibley College, Cornell University, on the organization, work and field of usefulness of the college shop, which will, we doubt not, attract wide attention among educators.

The precise nature of the work which the college shop has marked out for it was never before, we believe, so clearly presented. There has been no end of confusion not only about this but about the corresponding fields of the manual training and the trade school, which have not only been considered to overlap, but by many to occupy largely the same ground. Even where the difference has been clear in a writer's mind, it has not been made clear to the reader, although, as a matter of fact, it has been as broad and deep as a difference could well be.

No words could possibly make the distinction so clear as do Professor Kimball's illustrations of the old and the new exercises at Sibley College. The former did little beside educating the student's hands in deftness in the manipulation of tools, while, to the latter, this is an entirely secondary object, their principal object being the teaching of fundamental principles, which enter the work of a productive shop, and the relative values of different methods of production.

With equal clearness the article points out the limitations which the conditions of the college shop set on the doing of commercial work in shops. Many have pointed out before the fact that the doing of this work only necessitates the giving of the best work to the best workmen among the students, with the result that the poorer students get the poorer work and are shut out from gaining experience on work of a higher grade, and in some cases this line of reasoning has led to the exclusion of commercial work entirely. By Professor Kimball's methods this fundamental difficulty with commercial work is met by giving the student exercise work at the beginning, while the opportunity to do commercial work as he acquires skill is held up to him as a legitimate reward for activity and devotion. The spirit of getting the work done instead of spending a certain number of hours in the shop is thus instilled from the beginning, and one of the greatest difficulties of the shop teacher is eliminated, except for those students who have no interest in their work, and it may well be questioned if it is worth while to attempt to adapt a course of instruction to students of that class.

We take this article as, first of all, an indication that the college shop has at last found itself. After thirty years of efforts, some good and some bad, we have here a summation of the situation and a definite key-note of progress. We do not intend by this to imply that other shop educators will, or should, agree with all of Professor Kimball's opinions; but all will, we think, agree that the definite aim of the college shop has never before been so clearly stated, that the methods given in his article are a logical outcome of this aim, and that they are excellently adapted to accomplish the object sought.

New Publications.

"The Prospects of Rubber Cultivation in Ceylon." By Henry M. Alleyn. 20 5½x8½-inch pages. The Times of Ceylon press, Columbo, Ceylon.

This essay is of large indirect interest to the many mechanical industries in which rubber is an important factor. The author analyzes his own and others' experience in the cultivation of rubber in Ceylon, and concludes that the soil, climate and other conditions are favorable to the industry, and predicts large developments of it and large profits for those who engage in it, with a corresponding increase in the supply in the near future. A rubber plantation requires about five years to reach the productive stage, and he expects the present prices of the material to hold for about this time or a little less, after which he anticipates a fall in prices. In this, however, we think he fails to take sufficient account of the rapidly expanding demand, his expectations being based almost entirely on the increased production which he anticipates. This, however, is in keeping with the rest of his argument, which throughout appears to be extremely conservative. If his findings regarding the suitability of climatic and other conditions and the profits in sight are approximately correct, the mechanical world may dismiss its fears regarding any possible future shortage of the supply of crude rubber.

"A Treatise on the Law of Foreign Business Corporations Doing Business in the State of New York." By John Henry Mann. 516 6x9-inch pages. Banks & Co., Albany, N. Y. Price $3.50, delivered.

Corporation law is regarded by students of jurisprudence as one of the most difficult subjects they have to encounter, not because it, like real estate law, is filled with metaphysical subtleties, but because of the general confusion, mix-up and uncertainties which it involves. For a corporation officer to neglect posting himself so far as he can on the legal aspects of the business he has undertaken, is wilfully to walk into loss or crime, since, as things are managed in these days, it is a piece of sheer luck when he escapes either being cheated himself or being made a tool to cheat someone else. The same remark is more or less applicable to stockholders. It is for the corporate official as well as for the members of the bar, that the author intends this book. He has not, however, attempted a milk-for-babes style but writes in the ordinary law text-book manner, building up his narrative from

statutes and cases, in language which can, we think, be understood by the common people so far as they can grasp this superficially easy, but really incomprehensible, subject. As intimated in the title, the treatise relates especially to the laws of foreign corporations, that is to say those chartered in one State and doing business in another—specifically, in the State of New York. As regards the relations between other States, it might be instructive but would be far less authoritative. It is hardly necessary to say that for many years past corporations have been breeding like mosquitos on the Jersey meadows and swarming across the river to New York City, carrying with them various specimens of the legal bacteria of their native environment. Similar hatcheries exist in Maine, West Virginia, Connecticut, Delaware, etc. If it is difficult to know the rights and obligations of a corporation in its own State, how much more puzzling is it where foreign relations are involved, since every jurisdiction has its legal peculiarities, and often when there is a conflict the Angel Gabriel could not foretell which law will be followed by the court. Persons who believe in a big, strong, centralized, imperial, one-man-power American Nation will be shocked to learn from page 2 of the book that the New York Court of Appeals still holds the U. S. Government to be a foreign corporation. It is not our purpose to review this treatise in the sense of passing positive judgment upon it, though so far as we have looked into it we like it. The author has provided an appendix of New York corporation statutes.

"The I. C. S. System of Instruction by Mail and the Results Achieved." Second edition. The International Correspondence Schools, International Text Book Company, Proprietors, Scranton, Penn. 204 6¼x9-inch pages; cloth. This "blue-book" contains a list of 75,500 students who have completed courses of instruction and received diplomas, or who have advanced to a completion of one-third or more of a regular course, excluding students who, instead of taking a complete course, have enrolled for merely one or two subjects, such as arithmetic and bookkeeping. We are informed that in addition to the students whose names are given in this book over 225,000 have completed preliminary subjects, and many thousands more, while taking out courses, are studying without sending in their work for correction, so that their names are not included in the register. During the time that the records were examined for the preparation of the second edition the average total number of students of all kinds carried on the roll was nearly 800,000, and as experience has shown that about two-thirds of these are students who study, the average number of active students and graduates was at that time over 532,000. The book includes 14.17 per cent. of these. These figures are a strong evidence of the great magnitude to which this educational agency has grown. The book is simply a catalog of students, with an introduction, and list of subjects included in the courses; it is arranged according to States and foreign countries, and sub-divided according to cities and towns. Besides the name and address of each student, the year in which he enrolled, the course of instruction which he took, and the number of subjects and drawing plates completed, is given, and if the student has received a diploma for the completion of the course, this fact is also indicated.

"Valve gears for Steam Engines", By Cecil H. Peabody. Second Edition, 142 6x9-inch pages, with 33 folded plates. John Wiley & Sons, New York. Chapman & Hall, London. Price $2.50.

This edition of a well known book is quite extensively revised from the first edition and with corresponding improvement. The first edition was quite mathematical, and while this feature has been retained, the analytical work has now been placed in an appendix where it does not interrupt the continuity of the work, the actual design of valve gears being by purely graphical methods. Unlike most American books on this subject, this one includes a discussion of radial and of drop cut-off gears.

"Variation in Power and Efficiency of Turbines Due to Changing Heads with the Revolutions Constant." By W. M. White, 10 8½x10½-inch pages with 3 full page plates. The I. P. Morris Company, Philadelphia.

Having occasion to design a turbine capable of giving 13,500 horse-power under a head which varied between 50 and 70 feet while the revolutions had of course to be kept constant, the I. P. Morris Company was called upon to investigate the effect of the conditions on the efficiency and power and have published the results in this bulletin which will be found of interest and value by all hydraulic engineers.

"Injectors: their Theory, Construction and Use." By W. W. F. Pullen. Third edition, 208 5x7-inch pages, with 148 illustrations. The Technical Publishing Company, Manchester and London. The D. Van Nostrand Company, New York. Price $1.50.

The third edition of this standard treatise has been extensively revised in order to bring it into accord with the many recent experiments on steam jets which have been brought about by the growing importance of the steam turbine. The book opens with an elementary explanation of the action of the injector and then takes up the various patterns of American, English and Continental injectors, of which it gives very clear illustrations and descriptions. Injector calculations are then explained, after which the ejector condenser, the water jet pump and other forms of jet apparatus are described. The book concludes with an account of the historical development of injectors.

"Practical Guide for Firemen," By W. H. Wakeman. Second edition, 93 4½x6-inch pages, illustrated. Published by the Author, New Haven, Conn. Price 50 cents.

This is one of several practical books by the same author on the management of steam engines. The present volume is intended to instruct the young fireman in his duties and in the use and management of the various accessories of a steam power plant.

A new technical journal has made its appearance under the title of *The Illuminating Engineer*. This does not mean that it is devoted to the interests of those engineers who are themselves illuminating, but it has to do with the engineering of illumination, and the new journal gives full particulars about the launching of a new engineering society, known as The Illuminating Society, of which Louis B. Marks is the president; A. Pope and C. H. Sharp, the vice-presidents; V. R. Lansingh, treasurer; and E. L. Elliott, secretary. A full account of the proceedings at the first meeting of the society is given, and the new society and the new journal seem both to have started off under excellent auspices. E. Leavenworth Elliott is editor of the new journal, which is 6¾x10 inches, but can probably be trimmed by those who wish to preserve it to standard size—6x9 inches, which we think is what the publishers should make it, so that it will conform to the size of the transactions of the various technical societies.

We have received a pamphlet reprint of a statement made by John Barrett, American minister to Colombia, in which he sets forth his reasons for believing that one of the important reforms needed in our consular service is to secure Americans for the vice and deputy consuls, instead of as at present employing natives of the countries in which the consulates are situated. Mr. Barrett thinks that the present plan prejudices the interests both of America and of foreign countries, and that it would be much better to have Americans in these positions.

Consul General Guenther, of Frankfort, reports that a French engineer, George Claude, has succeeded in separating oxygen and nitrogen in atmospheric air, this result having been reached through the liquefaction of air. Prof. Raoul Pictet, of Berlin, has also been working for some years on this problem, and has succeeded by liquefying the air and allowing the nitrogen to evaporate in obtaining a product which contained about 50 per cent. of oxygen, and which he intends to put on the market as "technical oxygen."

New Tools and Machine Shop Appliances.

AN ELLIPTICAL BORING, TURNING AND MILLING MACHINE.

This machine was designed for the use of boilermakers, shipbuilders, etc., for cutting man-holes, port-holes in vessels, heads, hand-holes, fire doors and fire-box rings; but it has been suggested that it might also be adapted for engraving.

With it ellipses, both internal and external, may be cut to a depth of 16 inches. Ovals can be cut out of solid plates with an ordinary square-nosed tool.

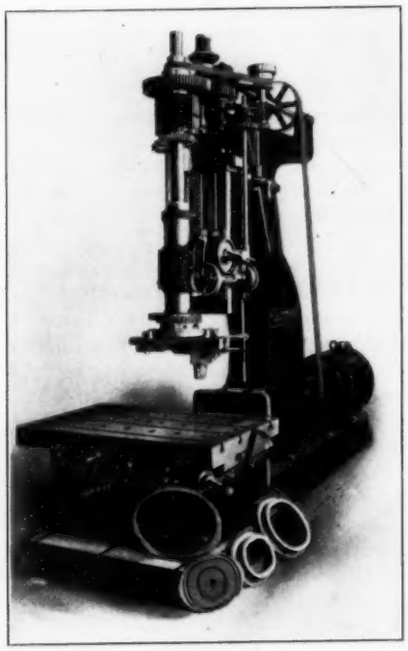


FIG. 1. AN ELLIPTICAL BORING, TURNING AND MILLING MACHINE.

By changing gears, quasi-triangular, square and various regular and irregular shapes can be turned, some of which can be adapted for rotary blowers or pump wings of two, three or more angular shapes.

This machine will cut, turn and face ovals of any size within its capacity, the difference between the length and width varying from the circle to 9 inches longer than width, without pattern or form. By throwing out the idler the machine cuts round.

The face and lower part of the frame is for clamping elbows and T's for facing and round turning. The same facing-head is used for ovals and other shapes.

The tapping attachment is arranged with a positive clutch. The table is hand-driven but can be arranged with automatic feed for milling if desired. The spindle will carry milling cutters of any size up to 10 inches.

This machine is also built as an ordinary heavy drill, with or without facing-head or tapping attachment, for bridge work, architectural iron work, frogs, switches and where other heavy drilling and tapping is required. A number of plates can be clamped on the table and accurately drilled.

Fig. 2 shows scrolls made by this machine. A variety of other shapes can be made. A special machine for engraving will be constructed.

The total hight of the machine, with the spindle at the highest point, is 12 feet. The table is 48x30 inches. Traverses of the table 46 and 24 inches. Greatest distance from the end of the spindle to the table is 56 inches, the least distance 24 inches. Traverse of the spindle 32 inches. The spindle is 3½ inches diameter and has a range of speeds from 3 to 120 r.p.m. The ratio of gearing is 40 to 1. The floor space necessary is 116x42 inches. The machine weighs about 13,000 pounds and will handle ovals up to 28 inches major axis. It is made by the C. C. Wais Machine Company, Cincinnati, Ohio.

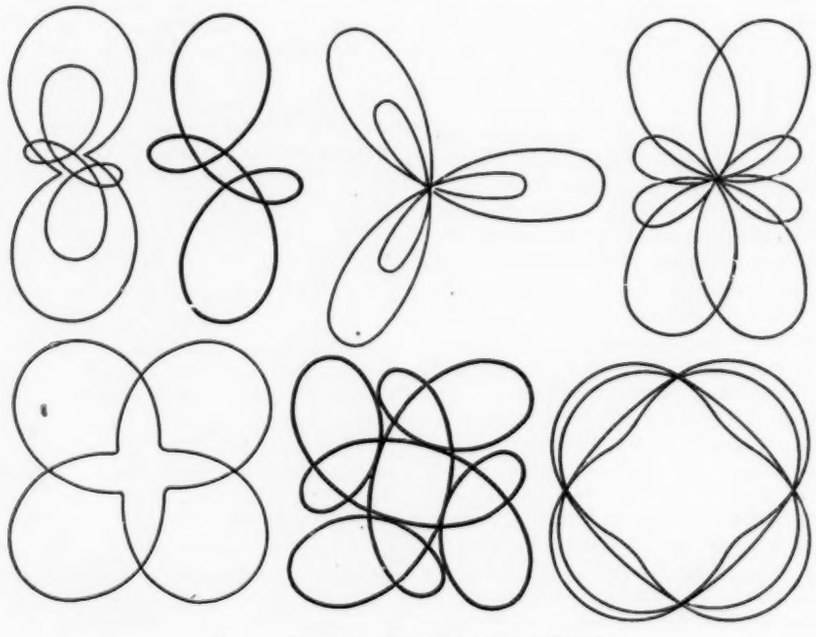


FIG. 2. SOME OF THE GEOMETRIC FIGURES.

A PRESS WITH SPECIAL FEEDS.

The accompanying half-tone represents a small power press with special chute feed.

This device is used for automatically feeding small cups, like Fig. 1, into the die, the operation depending upon the style of die employed. In this particular instance the edge of the cup was curled over, as in Fig. 2.

FIG. 1

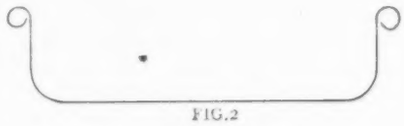


FIG. 2

THE WORK.

The feed is operated by the rod *A*, connected at one end to the shaft by the adjustable crank block *B*, and at the other end to the small arm *C* operating the lever *D*, which is connected to the push slide *E* by the link *F*. *G* is a small arm connected to the side of the slide having a finger which, when the slide descends, trips the stop gage *H*, allowing but one shell to drop at a time; otherwise there would be a crowding of the shells. After the shell has dropped beyond the stop

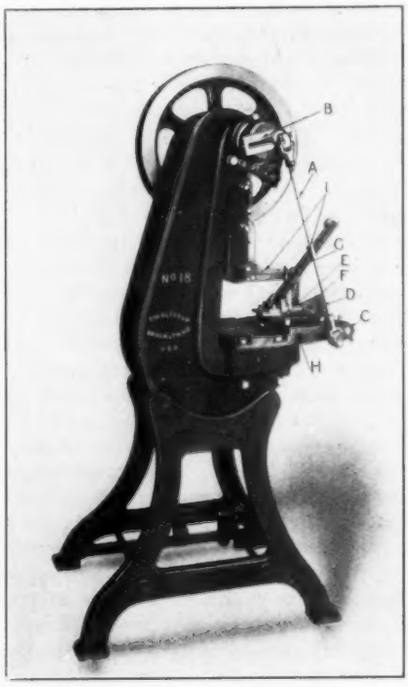


FIG. 3. A PRESS WITH SPECIAL FEEDS.

gage, it is advanced under the die, which is not shown, by the push feed, where it is operated upon. After the operation the next shell comes along and pushes the previous shell out of the way. The arm *I* is simply a support for the chute, bolted to one of the gibs and the bed.

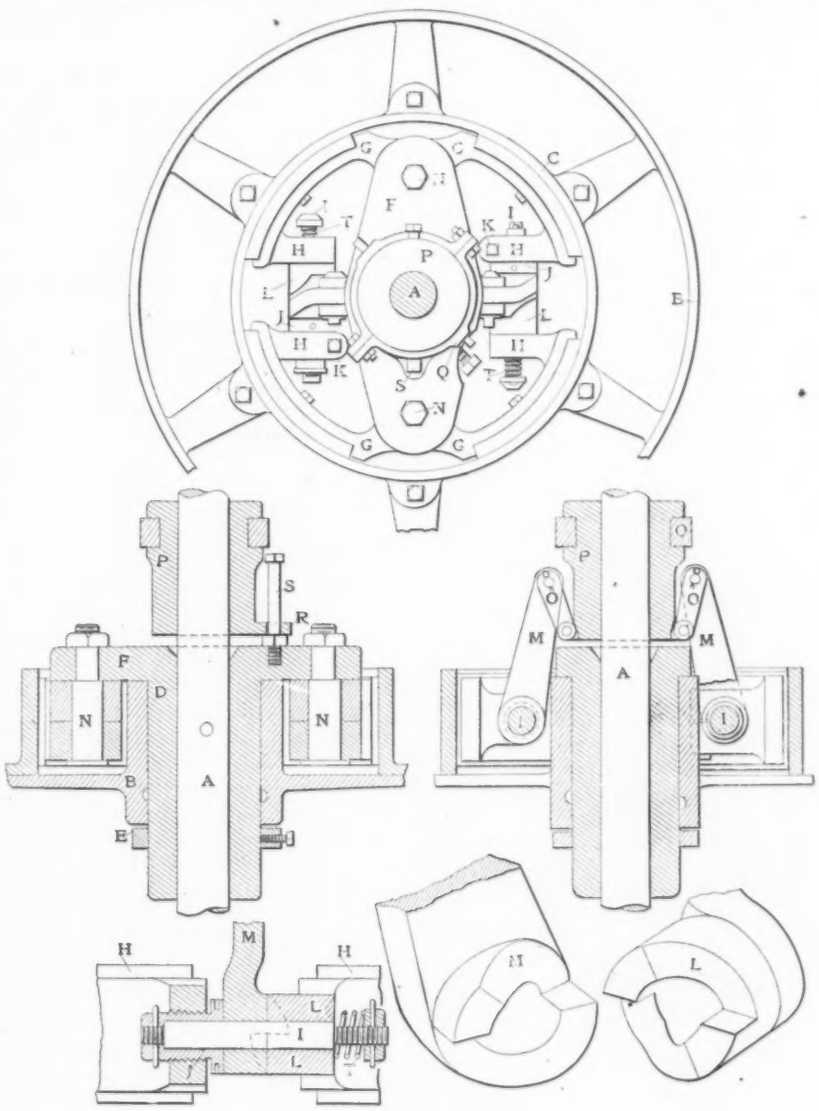
The press is run at 60 r.p.m., making as many operations without danger to the operator, as there is no occasion for him to put his fingers anywhere near the die.

This machine has just been built by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

A FRICTION CLUTCH.

The line cuts show the mechanism of a friction-clutch pulley.

A is the shaft, *B* is the pulley, to the



A FRICTION CLUTCH.

arms of which the friction ring *C* is bolted. *D* is a sleeve secured to *A*, upon it the hub of the pulley *B* is journaled. A collar *E* at one end prevents the pulley moving end-ways in that direction, while a flange *F* on the other end of *D* prevents it moving in the opposite direction. The lugs of *F* have a pair of clutch shoes *G* pivotally bolted to each of them by the bolts *N*. The clutch shoes *G* are lagged with suitable frictional material such as wood.

The ends of the clutch shoes *G* furthest from the pivots *N* are provided with angular projections *H*, through these projections are holes for the bolts *I*. Two of these angular ends *H* are threaded to receive the threaded sleeves *J* which are provided with a flange and pilot holes for adjusting them in or out of *H*. These two members *H* are also split and the two bolts *K* passing through them at right angles to these splits are used to clamp the sleeves *J* when their adjustment is correct. The other two members *H* are provided with cam faces *L* which fit similar faces on the two levers *M*. The other ends of the levers *M* are pivoted to the ends of the links *O*, the other ends of which are pivoted to the sliding collar *P* which is movable longitudinally on the shaft *A*. The collar *P* is provided with a groove in which works the split ring *Q* having trunnions by which it is connected to a shifter lever (not shown).

The collar *P* has a lug *R* on one side of it, through which is a clearance hole to receive the bolt *S*, screwed into *F*. The object of *S* is to limit the movement of the collar *P* on the shaft *A*. In practice the shoes are normally out of frictional engagement with the ring *C* on the pulley *B*.

When it is desired to throw the clutch into engagement, the collar *P* is moved away from *F*, this forces the links *O* up at right angles with the shaft, which operation turns the levers *M* on their bearings on the pins *I*. The cam faces *L* and *M*, swing the clutch shoes *G*, on the bolts *N*, and force them into frictional contact with the inner surface of the friction ring *C*. Throwing the collar *P* in the opposite direction releases the clutch shoes *G*, the springs *T* then draw the clutch shoes back out of contact with the friction ring *C*. This friction clutch is manufactured by John Rieppel, Cowanesque, Tioga county, Pennsylvania.

THE LINCOLN VARIABLE-SPEED MOTOR.

We illustrate herewith a very interesting new design of variable-speed motor made by the Lincoln Electric Manufacturing Company, of Cleveland, Ohio. The increase of speed is obtained by decreasing the magnetic flux by lateral displacement of the armature, which withdraws it from the influence of the field poles. In addition to this the armature is conical in external form, its endwise displacement being thus made to vary the width of the air gap, thus giving a greater variation of speed for a given lateral displacement than would result from a cylindrical armature.

FIG. 1. THE LINCOLN VARIABLE-SPEED MOTOR.

The general appearance of the motor is shown in Fig. 1, while Fig. 2 gives end and sectional views. To avoid sparking at high speeds a series of special commutating poles *a*, Fig. 2, is provided, the armature coming under the influence of these poles as its speed increases. By the use of these poles in combination with the fact that the strength of the main

poles *b* is not weakened for high speed, a speed variation of 10 to 1 or even higher may be obtained, the horse-power being constant at all speeds, the torque varying inversely with the speed. The manipulation of the motor for variation of speed is by the hand wheel shown, which, of course, gives an indefinitely small increment of speed. The hand wheel acts through the screw, spring and bent forked lever shown to withdraw the sleeve which carries the main bearing. The magnetic pull on the armature makes a thrust bearing necessary and this is a ball bearing which takes the radial as well as the thrust loads.

It will be observed that no controller is used.

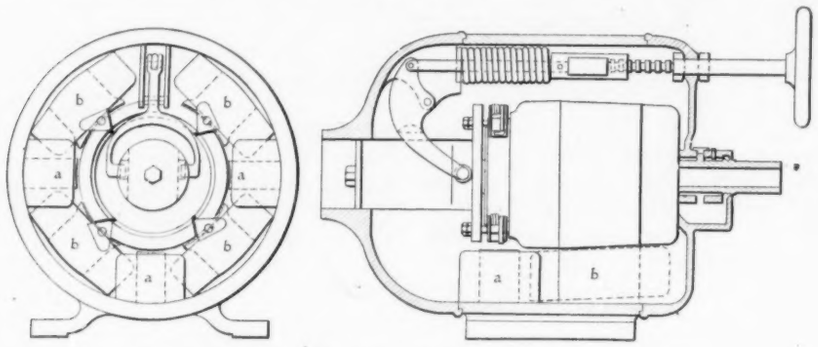


FIG. 2. ELEVATION AND SECTION OF LINCOLN MOTOR.

A SENSITIVE DRILLING ATTACHMENT.

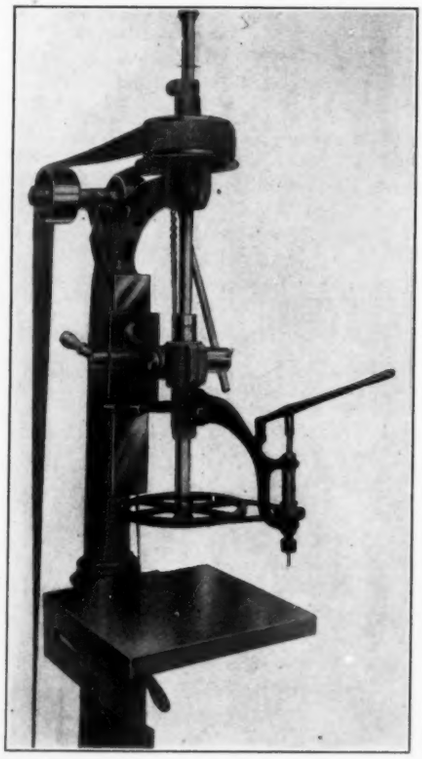
The illustration shows a handy sensitive drilling attachment which can be applied to large drill presses. The attachment is clamped to the quill of the drill press. The large grooved driving pulley is secured to a taper shank which fits the drill-press spindle. The small driven pulley on the attachment has two speeds, either of which may be placed in line with the driving pulley by clamping the attachment to the quill at the desired hight. The belt is of twisted leather, and may be shortened or lengthened by twisting or untwisting. The feed of the attachment spindle is by means of the small lever shown, and is very senitive. A further advantage of this attachment is that it adds six inches to the swing of the drill press to which it applied. It is supplied either with or without a drill chuck, and is made by Edward Board & Co., 618 Chestnut St., Philadelphia, Penn.

Balancing at High Speed.

E. R. Douglass, the author of the article at page 240, on "Balancing at High Speeds," recently received from a reader connected with a firm of wood-working machinery builders a letter of inquiry relative to apparatus for use in balancing such parts as cutter heads and pulleys which operate at speeds up to 5000 turns per minute. The following particulars given in his reply will be of interest to those having to do with high-speed balancing:

We have no special machine for this work. Our work is quite large and heavy compared to the parts of wood-working machinery and runs at from 1900 to 3600 revolutions per minute. We support it in babbitt-lined gray-iron boxes, which are cooled by water jackets on the outside and lubricated by a good grade of oil fed in at several points on each side of the bearing through small flexible tubes. These bearings we support elastically by resting them on cushions of rubber.

Owing to the flexibility of the shafts and the weight which would be required in supporting frames for a perfectly free horizontal mounting, we are not able to work with negligible elasticity; hence we find it as convenient to include its effects in our tests, especially as we are easily able, by running first in one direction and then in the other, to make allowance for it.



A SENSITIVE DRILLING ATTACHMENT.

We drive by a light belt from an electric motor on the floor above. Having convenient means of varying the speed of this motor through a wide range and of using it as an "electric brake" when slowing down, we can run off tests pretty rapidly.

With bearings lubricated in this way some oil leaks out at each end and drops into a pan below, or, being slung off from the shaft, is caught by tin oil guards. The majority of the oil circulates, however, from the supply tank in at one side of the bearing and out at the other, going back through the tubes to the tank. It is accompanied in its return by some bubbles, which are apparently sucked into the bearing at its ends on the low-pressure side.

We apply the chalk on the vertical axis, holding it very lightly in the fingers and resting the hand on a light support over the rotor.

We find it necessary, in order to get the most accurate results, to *grind* the reference rings over the balancing pockets by a small motor-driven emery wheel, while the work is turned slowly in its own bearings, which are blocked rigidly during the job. If the lathe work has been carefully done, this is not a long operation, as the reference rings do not need to be over ¾ or 1 inch wide. The surface left by the emery wheel is also excellently adapted to retain the lightest touches of the chalk. To preserve this surface, we clean the marks off with benzine rather than with sandpaper.

In view of the present agitation for the rendering available of alcohol for use as a fuel for motors, etc., a recent German invention described by Consul Halstead is of interest. This process is the invention of Prof. Alexander Classen, of the Aix-la-Chapelle Technical High School. The essence of the process consists of the treatment of the sawdust with gaseous sulphurous acid, the process being carried on in various forms of apparatus and lasting several hours, at the end of which time a strong sugar solution is obtained, 450 to 500 pounds of sugar being obtained from a long ton of dry sawdust. The sugar solution is then in another vessel neutralized with carbonate of lime, and is then pumped into a fermenting vat, where yeast is added, and after fermentation the product is distilled so that about 50 gallons of crude alcohol or 25 gallons of absolute alcohol are obtained from a long ton of sawdust.

It is intended to hold in Cincinnati between August 28 and September 22 a Fall Festival and Industrial Exposition for which an elaborate program has been arranged, and which is under the direction of prominent citizens of the city. It will be similar but more elaborate than the series of exhibitions held there some years ago. Particulars may be obtained by addressing Chairman Committee on exhibits, The Cincinnati Fall Festival Ass'n Company, Cincinnati, Ohio.

An Instantaneous Positive Speed Variator.

BY H. F. NOYES.

The problem of a speed variator which shall be positive and instantly available seems to be still open to discussion. In designing the one illustrated in the drawings I started under the following limiting conditions:

A constant belt speed to the first motion shaft; a positive drive therefrom; a variator which would be practically instantaneous, and which could be operated without stopping the machine. In addition to these it was considered very desirable that the change be made without shock and while under load. This latter feature I have not seen heretofore touched upon, except in frictional devices, and they were not positive enough to meet the conditions.

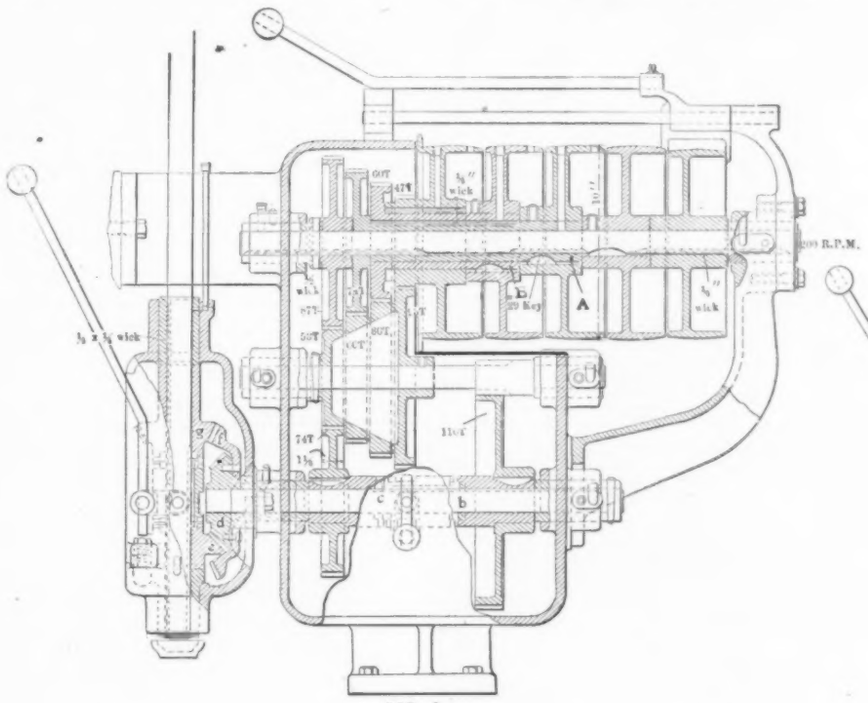


FIG. 1

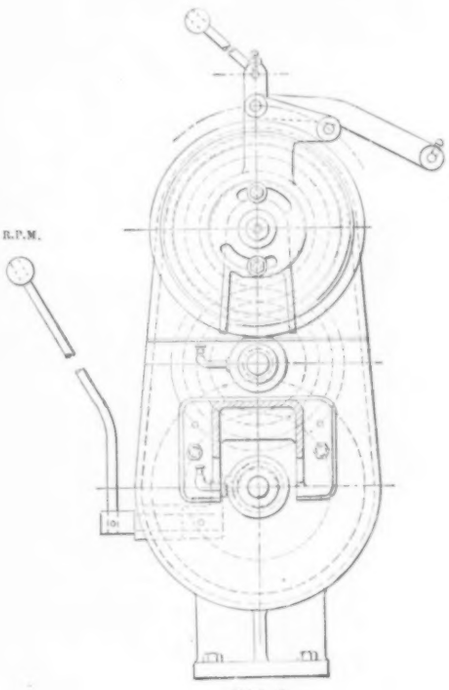


FIG. 2

INSTANTANEOUS SPEED VARIATOR.

The device illustrated was designed for a small horizontal drilling and boring machine. It was desired to obtain a range of eight speeds, practically in geometrical progression, from about 15 to 250 revolutions per minute.

Fig. 1 is a vertical sectional elevation, and Fig. 2 an end elevation of the device. Referring to Fig. 1, five pulleys are shown, all of the same diameter, the outer being a loose pulley, and all mounted upon the first-motion shaft. The pulley next to the loose pulley is fastened to this shaft, and at the inner end of the shaft an 87-tooth gear is fastened. The next pulley is fastened to the sleeve *A* of a 74-tooth gear, which runs loose upon the shaft; the next to the sleeve *B* of a 60-tooth gear, which sleeve runs loose upon the sleeve *A*, and which drives the shaft, a lever being provided to throw this clutch into engagement with one or the other of the two gears. To maintain the proper distance between the clutches, two case-hardened rings, *b c*, are milled to receive the ends of the key upon which the clutch slides. The shaft is provided at its inner end with two bevel gears, one 40-tooth gear *d* engaging a 40-tooth gear *e* upon the vertical shaft, and one 64-tooth gear *f* engaging a 34-tooth gear *g* on the vertical shaft. The 40 and 34-tooth gears run idle upon their shaft, being provided with clutches to engage a sliding clutch which is keyed to the shaft, the lower or 40-tooth gear being designed to drive direct, while the upper gear is used for reversing at a proportionately faster speed. For oiling all idle-running parts, small wicks are provided suitably connected with oil cups.

The first-motion shaft is designed to run at a speed of 200 revolutions per minute. This would give the intermediate shaft four speeds of 328, 224, 150 and 101 revolutions per minute. It is evident that these speeds are obtained by merely shifting the belt from one pulley to another. When the belt is on the pulley connecting with the 87-tooth gear, the intermediate shaft is driven at a speed of 328 revolutions, the 93-tooth gear is driving the 47-tooth gear and its pulley at 650 revolutions, which might seem rather fast at first thought; but, considering that this is running on the sleeve of the 60-tooth gear, which is running at a speed of 432 revolutions, there is only a difference of 218 revolutions. The peripheral speed of the 93-tooth gear at this rotative speed would be about 780 feet per minute.

With the 110-tooth clutch gear in engagement we have four speeds of 14, 23, 34 and 49, and with the 74-tooth gear speeds of 76, 107, 160 and 230.

It will of course be argued that on the first-motion shaft we have a good many moving parts and some slight additional friction. This and the fact that we have in one case a rather high peripheral speed for the gears seem to be the objectionable features of this design, together with the fact that it is rather roomy. On the other hand, the advantage of being able to instantly obtain any of the speed variations while running without shock, and while *under load*, without the operator's leaving his seat, seem to me to far outweigh the slight objections.

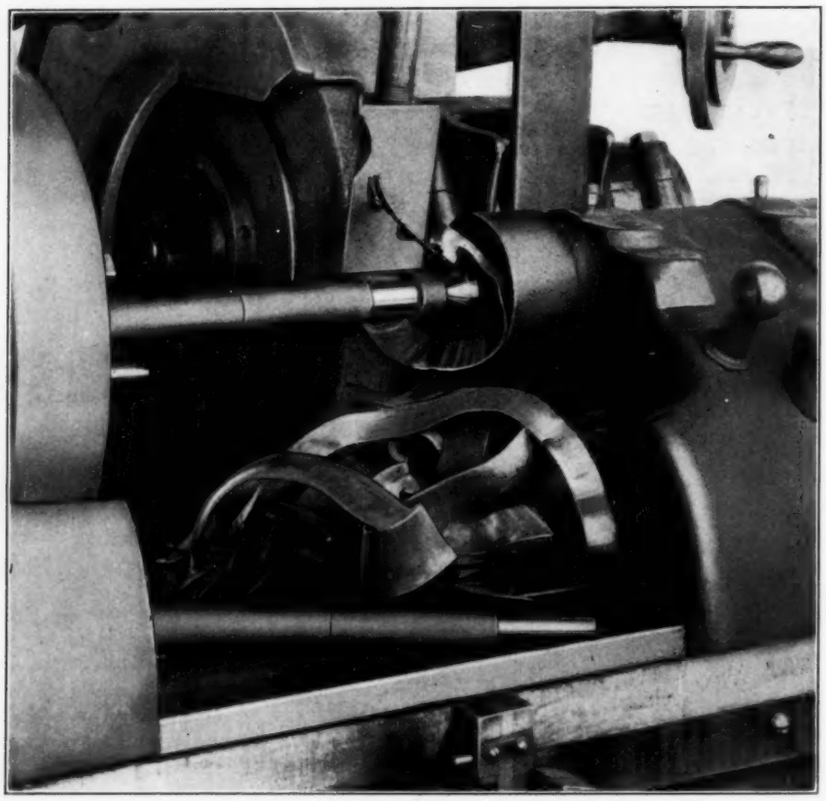
A great difficulty in the production of power from peat gas is the rapid formation of tar. This has to be separated and constitutes a serious loss of heat.—*The Engineer.*

Some Remarkable Grinding Chips.

BY H. F. NOYES.

Every mechanic, who has been asked for his opinion as to how the chips shown in the half-tone were produced, judging from a sample, has invariably stated that they were not and could not be produced in the form by grinding shown.

Our representative, on showing these samples on his travels and stating that they were grinding chips,. has been met with the "squint eye," the merry ha-ha, has been called a liar, a ——— liar, accused of being drunk, and has had altogether a strenuous existence. The method



A PECULIAR GRINDER CHIP.

of producing the freak, if it may be so called, was accidentally discovered while doing regular work on a medium-sized machine.

The part operated on, as will be seen from the half-tone, was a small spindle. The operation was reducing the end of this spindle, from 1 3/16 to 15/32 inch in diameter for a distance of about 2¼ inches back from the end. The wheel used was 1½ inches face, and was first sunk in without traversing until the required diameter was obtained, leaving about ¾ inch at the end which was then reduced to the same diameter in the same manner. These two operations constituted a roughing cut, and the end was afterward finished in the usual manner. A completely roughed out spindle is shown lying on the bed of the machine. It was from the first sinking in that the best chips were obtained.

The material from which the spindles were made was about 40 carbon steel, hardened. The work was rotated very slowly, at a surface speed of about one foot per minute, while the emery wheel was run at about the maximum, 6000 feet. The best chips were obtained with the wheel slightly glazed.

During this operation 65 spindles of this description were roughed out and the metal was removed at the rate of 1¾ cubic inches per minute. The wear of the wheel, including truing up with a diamond several times, for roughing out the 65 spindles, was only 3/16 inch diameter. The wheel used was 18 inches in diameter, 1½ inches face, grain 46, grade L. Some of these chips were obtained in lengths of two feet or over with much the same curl as if they had come from a lathe.

Various theories have been proposed as to the cause of these chips. The most likely one seems to be that the rapid removal of metal and the very slow work speed allows a portion of the particles to become fused together as they leave the wheel. It is estimated that probably four times as much metal was removed at the time as was found in the fused chips. While the grinding operation is going on, the particles have the work in apparently, a solid red stream of metal. That considerable heat was generated at the point of contact is evident, yet the work was not allowed to become heated.

The work was done on a No. 22 Landis grinder, a 12-inch swing machine. The weight of headstock and footstock was about 500 pounds and of the emery-wheel base 500 pounds. The spindles ground were about 12 inches long.

It has been found to be advantageous to remove this large amount of metal on the grinder, not only on account of the rapidity of removal but also because before, when the end was roughed out on the lathe, and the spindles then hardened, there was considerable loss in hardening, the spindle snapping off or cracking near the shoulder, while now this difficulty is entirely obviated.

Fireproof Flooring Made from Wood.

Consul-General Mason, of Berlin, describes one of the wood-pulp jointless-flooring materials which are at present used in Germany. The one in question is known as "dolomeni," or stone wood, and is manufactured in Charlottenburg, near Berlin. Dolomeni is a plastic substance about the consistency of mortar, made of pulverized wood fiber, asbestos, and a mineral substance, and colored by the admixture of various oxides to any desirable color tint. The eight samples which were submitted as exhibits with the report show some of the shades in most common use; namely, terra cotta, gray, cream-white, and grained in imitation of red- or blue-veined marble. It is laid down in a smooth, even layer, half an inch thick, upon the beton, or cement substructure, which in German construction rests upon steel joists and forms the foundation of all floors, whether of wood, marble, or other materials. The problem has been to make a continuous flooring which will cover the entire area of an ordinary room, fit closely at its junctions with upright walls, and be not only fireproof, but impervious to liquids, dust, vermin of all kinds, a poor conductor of heat and sound, easily cleaned and withal neat and sightly in appearance. All these requirements appear to have been successfully reached by the material which is now under consideration. On the beton substructure and beneath the fireproof flooring is laid an insulating layer of a composition composed of fine cork chips, asbestos, sawdust and some cohesive matrix to hold the other ingredients together, the principal purpose of this layer being to permit of expansion and contraction, and some degree of settling, of the building, without producing cracks in the dolomeni.

We are informed that Mr. Colvin's excellent little book, "Link Motions, Valves and Valve Setting," which was noticed at page 427, is being sent gratuitously to all master mechanics and railroad superintendents of motive power by H. B. Underwood & Co., of 1025 Hamilton street, Philadelphia.

Personal.

Our contributor, Joseph V. Woodworth, has removed his consulting office to 383 Pearl street, Brooklyn, N. Y.

Arthur E. Palmer has resigned from the faculty of the Engineering Department of the University of Michigan to accept a position with the Gardner Engineering Company, Incorporated, of New York.

The initials and the present address are desired of a man named Jackson who, in 1897 or '98, was a foreman with the Frank Mossberg Company at Attleboro, Mass., and is believed to have since been located in Lynn, Mass. Anyone who can give this information will greatly oblige by sending it to the editor.

A. A. Schaefer, formerly associated with the Standard Engineering Company, of Ellwood City, Penn., acting in the capacity of general sales agent for New York City, and surrounding territory, is now associated with the Stoever Foundry and Manufacturing Company, making his headquarters in the New York office at 95 Liberty street.

At a meeting of the Board of Directors of the Westinghouse Electric and Manufacturing Company, held April 10, L. A. Osborne, formerly third vice-president of that company, was elected second vice-president to succeed Frank H. Taylor, resigned. Mr. Taylor, who is also a director of the company, will retain his seat on the Board.

Obituary.

Edward Cliff, president of the Cliff & Guibert Company, of New York City, and well known as an inventor of railroad appliances, died April 7 at his home on Riverside Drive, of heart disease. He was 62 years old.

Dean Nathaniel Southgate Shaler, of the Lawrence Scientific School, died at Cambridge, Mass., April 10, of pneumonia. He was born in Newport, Kentucky, sixty-five years ago. In 1859 he was graduated from Harvard. During the war he served as a captain in Shaler's battery, a Union organization. After the war he returned to Harvard, took up work as a teacher, and was rapidly advanced to a full professorship. Fifteen years ago he was made Dean of the school. It was due to his efforts that the McKay bequest of $5,000,000 was made to the institution a year ago.

Francis H. Saylor, president of the Philadelphia Bridge Works, died recently at Germantown, Penn., aged 62 years. Mr. Saylor was one of the best known railroad and bridge builders in this section of the country. He was born in Schuylkill Haven, Penn., was graduated from Amherst College in 1865 and from the Rensselaer Polytechnic Institute, Troy, N. Y., in 1868. In early life Mr. Saylor was civil engineer in the engineering department of the Philadelphia & Reading Railway. He surveyed, built and managed the Bound Brook Railroad between this city and New York. Later he superintended, as chief engineer, the construction of the Pittsburg & Lake Erie Railroad. At this time he was a member of the firm of Cofrode & Saylor, bridge builders, and had an extensive plant at Pottstown, Penn.

Lemuel Bannister, for many years vice-president of the Westinghouse Electric and Manufacturing Company, died April 13 at the Hotel Imperial, New York City, after an illness of several months. Mr. Bannister was born in a small town in northern New York in 1841. His first business ventures were in the lumber trade and for many years he was connected with R. DeWees Wood in that business in Philadelphia. Then he went into the electrical business, becoming connected with the Westinghouse company. He was vice-president of the New York house and practically at the head of the European business, to take charge of which he left America ten years ago. He built the electric railways in Berlin and other European cities. He was also in charge of the Pittsburg house for a time. He was a member of the Lawyers and Engineers clubs of New York and the Duquesne Club of Pittsburg.

Frank Chandler, of Chandler & Farquhar, Boston, Mass., and whose death at his home in Waverly, on April 4, was announced in our columns last week, was born in Augusta, Me., February 20, 1852. He was well known throughout New England. When a lad he lived at the Portsmouth Navy Yard, where his father, Commodore B. F. Chandler, had charge of certain improvements. He came to Boston when a young man, went to work for A. J. Wilkinson, and remained until he had learned the hardware business thoroughly. In 1882, with Mr. Farquhar, a fellow employee, he formed a partnership. The firm prospered, and today is one of the largest in New England in the machine-tool and hardware lines. It became a corporation in 1904, and Mr. Chandler was the senior member of the firm and its president. Mr. Chandler lived in Belmont, Mass., a suburb of Boston, for more than thirty years; he was chosen selectman several times, and in 1895 and 1896 he represented that town in the Legislature. He was a member of the National Supply and Machinery Dealers' Association, the New England Hardware Dealers' Association, the Boston Merchants' Association and a trustee of the Massachusetts Mechanics' Charitable Association. He leaves a widow and one son, F. A. Chandler, who was associated with him in business.

Business Items.

The Joseph Dixon Crucible Company at Jersey City, New Jersey, is sending out literature which relates to the various jobs of spring painting, which it is now time for, and which are being so generally done.

The Perkins Machine Company, Warren, Mass., builders of Perkins Power Presses are very busy. They have increased their capacity and are running until ten o'clock each night. They are six to twelve months behind with deliveries on some of their machines and their only complaint is lack of machinists and say they want more men.

The Leeds and Northrup Company, Philadelphia, has recently occupied its newly erected plant at 4901 Stenton Avenue, in that city. The new plant, which was designed primarily for the special requirements of constructing and adjusting electrical-measuring instruments, is of fire-proof construction throughout and has embodied in it many features of interest.

The Bay State Tool Company, formerly of Boston, Mass., manufacturers of the Bay State" quick-acting monkey wrenches; single and double-headed ratchet wrenches and other time-saving tools, has moved into its new factory and offices at 100 Beacon street, Worcester, Mass. The new factory is much larger than the old one and will enable this company to fill orders promptly.

The Allis-Chalmers Company, Milwaukee, Wis., sends us a sample proof of a series of 50 multi-chrome cards giving views of Swiss scenery, which they are preparing to send to customers for their Schindler Bolting Cloth. Thinking that others may be interested in them, they ask us to publish an item about it, which we take pleasure in doing, as the cards are certainly well worth having, and we hope many of our readers will secure them.

The new extensions to the West Allis, Milwaukee Works of the Allis-Chalmers Company which, when completed, will add 861,000 square feet to the plant's present floor area of 652,000 square feet and make the entire plant capable of affording employment to 11,000 persons, will place the West Allis Works among the large industrial plants of the country. The extended works, together with the capacities of the other works of the company in Milwaukee, Chicago, Cincinnati and Scranton, will be capable of affording employment to a total of approximately 18,000 persons.

The Cincinnati Lathe and Tool Company of Cncinnati, Ohio, has recently purchased the lathe business of The Fosdick Machine Tool Company of that city, which comprises the 16-in. lathe with W. T. Emmes Patent Feed Device. It is their intention to specialize on this particular machine and thereby developing it to its highest possible standard of efficiency and workmanship. Their plant is located in the heart of the machine-tool dstrict of the city, and is expected to be in running order by April 1, 1906, and is now in a position to book orders for future deliveries. The president of the company, W. C. Heindel has been connected with The Cincinnati Milling Machine Company for the past ten years, and its superintendent is A. B. Sowden.

At the second annual meeting and banquet of the Technical Publicity Association, held Thursday, April 5, at the Aldine Association, New York, the following officers were elected: President, F. H. Gale (General Electric Company); first vice-president, H. M. Cleaver (Niles-Bement-Pond Company); second vice-president, C. B. Morse (Ingersoll-Rand Company); secretary, Rodman Gilder (Crocker-Wheeler Company); treasurer, H. M. Davis (Sprague Electric Company); members of executive committee, Robert L. Winkley (Pope Manufacturing Company) and G. M. Basford

(American Locomotive Works); members of election committee, C. W. Beaver (Yale & Towne Manufacturing Company), Charles N. Manfred (Johns-Manville Company) and H. H. Kress (A. S. Cameron Steam Pump Works). The membership of the assocation shows a steady increase and its finances are in good condition. The following resolution was unanimously passed: Resolved, that the association shall take active steps to secure definite information regarding the circulation of mediums in which the members of the association are interested.

The Tudor Manufacturing Company, with offices at 147 Milk street, Boston, Mass., has just been incorporated under the Massachusetts laws and has purchased the business and equipment of the Bay State Tool Company of Boston, which has been principally an experimental concern. The company has perfected a line of quick-acting tools, including the Bay State Quick Acting Monkey Wrench, ratchet wrenches, compound lever punch, friction tire bolt wrench and other tools, which will be placed on the market later. The Tudor Manufacturing Company has taken the large brick factory building in Worcester, Mass., formerly occupied by the National Emery Wheel Company and will equip it with the most up-to-date tools to manufacture their goods in large quantities. They have prepared a list of their new machinery requirements, which will be installed in the company's new works at Worcester, Mass., as follows: Two No. 7 milling machines, vises and counters for each; two speed lathes, 6x12 in.; one Pratt & Whitney automatic screw machine; one Bardons & Oliver screw machine, No. 4; seven hand milling machines, vises and counters; two ¾-in. automatic screw machines; one No. 3 Bardons & Oliver screw machine; one Barnes 25-in. stationary-head drilling machine; one Barnes 26-in. sliding-head drilling-machine; one three-spindle drill for ¾-in. holes, geared; one Bardons & Oliver No. 2 screw machine; one Becker-Brainard No. 25 milling machine, vise and counter; one two-spindle drilling machine for ½-in. holes; two presses with 2½-in. stroke, one press with 7-in. stroke, etc. The officers of the Tudor Manufacturing Company, are: President and clerk, C. C. Marvel; treasurer, E. B. Page; directors, these officers and H. G. Broobs and W. C. Farrell. The authorized capital stock is $500,000.

Manufacturers.

The Scott Works, Reading, Pa., is erecting a new foundry.

The Androscoggin Pulp Mills, Brunswick, Me., were destroyed by fire.

The Smith Machinery Company, Milwaukee, Wis., will erect a new plant.

The Acme Machinery Company, Cleveland, Ohio, will erect a new crane shop.

The Scannell Boiler Works, Lowell, Mass., will build an addition to its plant.

The United Traction Company, Albany, N. Y., will enlarge its power plant.

The St. Johnsbury (Vt.) Gas Comyany has purchased site for a new plant

The Stamping and Tool Company, La Crosse, Wis., will erect a new plant.

The St. Paul (Minn.) Foundry Company will erect an addition to cost $15,000.

The Cuba (N. Y.) Wood Fiber and Plaster Company's plant was destroyed by fire.

The Malleable Iron Fittings Company, Branford, Conn, will erect a new plant.

A five-story facory building will be erected for the Cleveland (Ohio) Worsted Mills.

An addition will be built to the file shop of the Simonds Mfg. Co., Fitchburg, Mass.

The Reliance Boiler Works, Milwaukee, Wis., will soon build a new $50,000 plant.

The Brown Fence and Wire Company, Cleveland, Ohio, will erect a new factory.

The plant of the A. C. Lawrence Leather Company, Peabody, Mass., is being enlarged.

The Kuhlman Car Company will erect a new shop at its car works in Collinwood, O.

Swift & Company, Chicago, Ill., will establish a $1,000,000 packing plant at Portland, Ore.

The Cleveland (Ohio) Twist Drill Company will erect a $95,000 factory at its plant.

Robinson Brothers, of Anniston, Ala., will erect a spoke and handle factory in Birmingham, Ala.

The Beck Salt Company, Ogden, Utah, will erect a $25,000 refinery on its property at Kessler.

The Brown Fence and Wire Company, Cleveland, Ohio, will erect a new $20,000 factory.

The Dix Manufacturing Company, hardware, Baltimore, Md., will erect a new factory.

A $50,000 addition will be built to the plant of the York Manufacturing Company, York, Pa.

The Bigelow Company, New Haven, Conn., manufacturing boilers, will make additions to its plant.

The Laycock Power House Company, Indianapolis, Ind., will spend $80,000 in making additions.

The Montague City (Mass.) Rod Company will build an addition for the manufacture of steel rods.

The mills and box factory of J. A. Wilkinson, Bristol, Tenn., recently burned, will be rebuilt.

The Duluth (Minn.) Brass Works will erect a new plant, double the capacity of the present one.

The Illinois Steel Company will spend $100,000 in improvements to its mills at Bay View, Wis.

The Missouri Pacific Railroad will build new machine shops and locate terminals in Springfield, Mo.

The Bemis Brothers' Bag Company, Minneapolis, Minn., contemplates an addition to its factory.

The E. Sondheimer Company, Memphis, Tenn., will erect a new planing mill to cost about $50,000.

The machine and pattern shops of the International Heater Company, Utica, N. Y., will be enlarged.

The Union Malleable Iron Company will build an extensive addition to its plant at East Moline, Ill.

William R. Humphris, Lexington, Va., has purchased an ice factory and will install new machinery.

The International Fibre Company, Boston, Mass., will establish a $100,000 factory in Syracuse, N. Y.

The Singer Manufacturing Company will erect three new buildings at its plant in South Bend, Ind.

The Pintsch Compressing Company, of New York, has decided to erect a lighting plant at Florence, S. C.

The Fredonia (N. Y.) Preserving Company has decided to locate a $35,000 plant in Newfane, N. Y.

The Arcade Manufacturing Company, Freeport, Ill., has let contract for new brass and iron foundries.

The Boston & Maine Railroad will erect new shops in Somerville, Mass., at a cost of nearly $2,000,000.

The plant of the Enterprise Boiler Company, Youngstown, Ohio, was destroyed by fire. Loss $55,000.

The Studebaker Bros. Mfg. Co., South Bend, Ind., will build another five-story addition to its plant.

The Paraffine Paper Company has been formed at Otsego, Mich. Capital $15,000. H. B. Coleman, president.

The Anson & Hickson Sash and Door Company, Merrill, Wis., will establish a branch in Evansville, Ind.

The Thomas China Company, Lisbon, Ohio, making electric porcelain electrical supplies, will double its plant.

Half a million dollars will be expended in improving the plant of the Empire Iron and Steel Company, Niles, Ohio.

The Willmar (Minn.) Peat Fuel Company has been incorporated. Capital, $10,000. Bernard C. Sitz, president.

The B. F. Sturtevant Company, Hyde Park, Mass., is considering the question of building an addition to its plant.

The New York, New Haven & Hartford Railroad will erect a roundhouse and machine shop in Danbury, Conn.

H. P. Dilworth, Pittsburg, Pa., is one of the promoters of a concern to erect a large power plant near Springdale.

The Toledo, Peoria & Western Railroad will move its shops from Peoria to East Peoria, a suburb of Pekin, Ill.

The Rome (N. Y.) Saddlery Hardware Manufacturing Company, has been incorporated and will equip a factory.

The White Automobile Company, Cleveland, Ohio, is erecting a new plant in which nearly $500,000 will be invested.

Contract for the new plant for Harvey Hubbell, Bridgeport, Conn., manufacturing machine tools, etc., has been let.

The Jones & Hopkins Manufacturing Company, Nashville, Tenn., making steel ranges and stoves, will build a new foundry.

W. H. Murphy, Detroit, Mich., will erect an artificial ice plant which will represent an investment of $1,000,000, it is said.

The plant of the Gilbert Hunt Company, makers of farm machinery, Walla Walla, Wash., will be rebuilt on a larger scale.

The Western United Gas and Electric Company, Joliet, Ill., expects to spend more than a million dollars in improving its plant.

Contract has been awarded for the construction of a new factory for the Marshall-Wells Hardware Company, Duluth, Minn.

The Pope Manufacturing Company, Hartford, Conn., has taken out a permit for a new building to be used as a drop forging shop.

The railroad shops of the Southern Pacific Company at Sacramento, Cal., will be enlarged to about double the present capacity.

It is reported that the Rockford (Ill.) Malleable Iron Works, has practically completed arrangements for a site for its new plant.

The Board of Public Service of Youngstown, Ohio, is considering the erection of a new machine shop on the filter plant property.

The Peoria (Ill.) Brass Foundry and Heating Company has awarded contract for the construction of a new building to cost $12,000.

The New London (Conn.) Marine Iron Works request catalogs of iron and wood working machinery, machine shop and foundry equipment and supplies.

The West Side Heat, Light and Power Company, St. Paul, Minn., which is controlled by C. A. Stickney of the Stickney Engine Company and Oliver Crosby of the American Hoist and Derrick Company, will erect a power plant to furnish power for both concerns.

The Wabash Railroad has let the contract for the construction of new car shops at Decatur, Ill., at an aggregate cost of $400,000.

Fire at the Cold Spring, N. Y. plant of the J. B. & J. M. Cornell Company, iron works, was damaged by fire to an extent of $200,000.

The Nashville (Tenn.) Buckle Company will be organized to manufacture a new buckle, invented and patented by E. H. Roy, of that city.

The Pennsylvania Railroad will add new buildings to its Altoona, Pa., shops, which will cost nearly $500,000 and equipment $125,000 more.

The Otsego (Mich.) Coated Paper Company has been organized. Capital $125,000. George E Bardeen, president. Three build ings will be erected.

Fire destroyed the plant of the Foster Bros. Manufacturing Company, Utica, N. Y., makers of iron and brass beds and springs. Loss, about $350,000.

Frank B. Gilbreth, New York and Boston, has secured the contract to construct a $500,000 plant for the Champion Fibre Company at Canton, N. C.

It is reported that the Noel Construction Company, of Baltimore, Md., has been awarded contracts for erecting a new five-story building at Dayton, Ohio, for the National Cash Register Company. The new structure is to cost $1,000,000.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royality for good patented machine or tool. Box 282, AMER. MACH.

Working drawings. Experimental work. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, N. Y.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Full particulars of an engine or motor, suitable for Aeronautical use. About 100 D.H.P. Box 420, AMERICAN MACHINIST.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford st., Philadelphia, Pa.

Work Wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Manufacturers of iron and wood-working machinery, machine shop and foundry equipment and supplies are requested to send catalogs to the New London Marine Iron Works, New London, Conn.

Tool catalog No. 22, 950 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

Will pay for working drawing of hydraulic wheel press for general work, about 40" with 12' 6" centers, showing detailed working instructions of all parts and how to build it. Our finishing tools are limited to one 30" lathe and one 30" planer. L. B. L., 415 AMERICAN MACHINIST.

Wanted—Assistant superintendent not over 35 years, for machine shop near Philadelphia, employing about 400 hands on small interchangeable work. Must be thoroughly systematic man, experienced in the handling of men who can produce economical duplicate work in large quantities, even shell work. Position will pay at least $3000. Address with full particulars, Hapgoods, 1105 Penna. Bldg., Philadelphia, Pa.

Wanted—Experienced inspector on small interchangeable work. Must be practical mechanic who can handle men tactfully and insist on work being turned out accurately. Prefer man with previous experience on small firearms, typewriters, computing scales or similar lines. Will have entire charge of inspection department. Location near Philadelphia. Salary $1300. Address, Hapgoods, 1105 Penna. Building, Philadelphia, Pa.

For Sale.

For sale—Foundry, Wood & Iron machine shops, Albion, N. Y. Box 74.

For Sale—Bound volumes AMERICAN MACHINIST, 1880-1900 inclusive. Splendid condition. Box 419, AMERICAN MACHINIST.

Business Opportunities.

Wanted—A growing machine tool shop desires capable mechanical man who can invest in same. Good, legitimate opportunity. Address Manager, 408 AMERICAN MACHINIST.

Wanted—High-grade engineering salesman to manage a department for well-known machinery house in New York. Fine opportunity and attractive salary for man of exceptional ability who can show results. Must be thoroughly familiar with territory and be in position to invest from $2000 to $5000. In writing, give full details as to previous record and present salary and position. Address "Engineer," 434 AMERICAN MACHINIST.

A manufacturing concern having a varied line of machinery, wishes to dispose of one of its lines, which consists of stationary gasolene engines. These engines run in sizes of from 2 to 20 h.p. and are adapted for all kinds of work. Business in this line has run $50,000 a year. Patterns, drawings and good will will be sold at a reasonable figure. Parties desiring to add another line to their business, or those desirous of going into the manufacturing business will find this to be an interesting proposition. Address Gas Engine, 260, AMERICAN MACHINIST.

Wants.

Situation and help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Machinery manufacturer can form advantageous connection with expert business-getter. Box 460, AMERICAN MACHINIST.

An experienced designer of machine tools and of special machinery, tools and fixtures required by advanced manufacturers solicits correspondence from such. Address Box 436, AMERICAN MACHINIST.

Foreman tool-maker with technical education and an extensive experience in designing and making special machinery, tools and fixtures for modern manufacturing. Box 437, AMERICAN MACHINIST.

Position as superintendent or general foreman of machine shop or manufacturing plant. Have had wide experience and can give good references; am not open to any but firms of good standing. Parties paying less than $2000 a year need not answer. S E. Mercer, 4042 Michigan avenue, Chicago, Ill

IOWA.

Chief draftsman: a mechanical engineer, at present chief draftsman with a large manufacturing concern in the west. Box 269, AMERICAN MACHINIST.

MARYLAND.

Engineer and draftsman, 30, long experience on engines, boilers, dredging machinery, etc.; first-class estimater; desires change at once. Box 458, AMERICAN MACHINIST.

Designing draftsman, 30, 9 years' experience, general machine and manufacturing business, technical education, desires responsible position with first-class firm. Box 459, AMERICAN MACHINIST.

MASSACHUSETTS.

Foreman of metal-polishing room, of 20 years' experience, is desirous of a change. Box 456, AMERICAN MACHINIST.

Situation by first-class engineer, American, 36, married, strictly temperate, 18 years' experience in charge of factory, office building, and electric-power plants. Best references. Box 452, AMERICAN MACHINIST

MICHIGAN.

Wanted—Position as assistant superintendent by a technical graduate, age 30, with shop and drafting-room experience. Familiar with modern methods and a hustler. Box 422, AMERICAN MACHINIST.

NEW YORK.

Works Manager or Superintendent located near New York City, will be open for position by June first. Box 428, AMER. MACH.

Superintendent, practical, energetic, systematic and fully reliable, with best references, seeks position. Box 427, AM. M.

Chief draftsman, specialist on automatic machinery; broad general experience; practical mechanic; technical. Box 457, AM. M.

Designer, draftsman, 12 years' experience, stationary and marine steam engines, dredging machinery, wants position. Box 445, AMERICAN MACHINIST.

Designing draftsman, M. E., age 30, 2 years' shop, 9 years' office, on special machinery, tools, fixtures, devices. Inventive, practical good judgment, hustler. Box 414, AM. M.

General foreman (36), responsible man, practical mechanic, successful in producing first-class work at satisfactory cost, varied experience, desires change. Box 354, Am. M.

Production engineer, systematizer, cost expert, certified public accountant, open to good proposal for permanent connection with large, first-class manufacturing concern anywhere. C. P. A., 439, AMERICAN MACHINIST.

Young man, 28, technical graduate, experienced purchasing agent, cost accountant, good systematizer, capable of introducing premium system and setting allowances, designer of jigs and fixtures, desires change. Box 427, AMERICAN MACHINIST.

Capable, thoroughly practical, reasonable and intelligent party, free May 1, desires position managerial or executive capacity; fair remuneration; recognized authority on explosive engines. Might consider New York or Boston representation, exclusive territory, gas producers, etc. A. E P., 431 AM. M.

OHIO.

Young man with several years' experience in machinery manufacture desires position with well-established firm and chance to work into the business. Technical graduate, Northern Ohio preferred. Address Box 438, Am. M.

WISCONSIN.

A machine-shop inspector wishes a change. Address Box 440, AMERICAN MACHINIST.

An experienced foreman patternmaker desires situation; can handle men and work to best advantage. Box 444, Am. M.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—A good, capable, energetic man to take charge of machine and manufacturing shop in Connecticut. Address Lake, 407, AMERICAN MACHINIST.

Coremaker foreman for large foundry in New England. Good salary to man capable of handling 75 coremakers on high-grade work. Give full particulars as to age, experience, references, salary desired, and class of work most familiar with. Box 410, AM. M.

ILLINOIS.

Wanted—Jobbing foundry and machine shop desires correspondence with responsible man as manager and solicitor. City of 10,000, 100 miles from St Louis. Box 435, AM. M.

Wanted—man of business experience and recognized standing as engine expert to take charge of gas engine development for large manufacturing company. Box 403, AM. M.

Wanted—Foreman to take complete charge of a manufacturing and assembling department employing 75 men. Only those who are familiar with small, accurate, interchangeable work and are employed in a similar position need apply. State references and wages wanted. Correspondence confidential. Box 446, AMERICAN MACHINIST.

Wanted—General foreman for large shop making special machines. Only high-class, practical, experienced man of executive ability, who is holding similar position, will be considered. Requires man fully capable of handling 300 to 400 men. State if experienced in foundry work. Excellent opportunity. All communications held strictly confidential. Box 421, AMERICAN MACHINIST.

MASSACHUSETTS.

Expert gear cutting man; also one young

man for general office and shop assistant. Boston Gear Works, Boston, Mass.

Wanted—Draftsmen; two reliable and experienced men on web printing presses and kindred machinery; applicants must state age, experience and terms. Box 453, Am. M.

Wanted—Two mechanical draftsmen. Men with some experience in structural steel work or steam boiler construction preferred. Location near Boston. Box 404, Am. Mach.

Wanted—Man (preferably 35 to 40 years of age) thoroughly competent to take charge of inspection in modern shop, manufacturing complicated automatic machinery. Wide experience in connection with the interchangeable production of small parts, made to very close limits of accuracy, is essential. State age, salary, and give references. No applicant will be accepted without careful investigation of previous record. Box 433, Am. M.

MINNESOTA.

Wanted—A competent foreman for a general machine shop in the Northwest, employing about 200 men. Must be capable of taking entire charge of plant and show results. To such a man we are willing to pay a good salary. Address, with full particulars, D. I. W., Box 454, American Machinist.

NEW JERSEY.

Draftsmen—We have positions now open for draftsmen. Call or address Henry R. Worthington, Harrison, N. J.

Wanted—First-class draftsman with experience on high speed automatic cut-off engines. Reply, stating experience and pay expected. Box 441, Am. M.

Wanted—First-class lathe and vise men for small steel work. Steady work, good pay, no trouble. Twenty-five miles from New York City. Box 194, American Machinist.

Wanted—A first-class mechanical draftsman on electrical machinery; state salary expected and when ready to work; wanted by a factory in New Jersey, 20 minutes from New York. Box 447, American Mach.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted — Foreman accustomed to production of light interchangeable work, must also be good toolmaker, fully conversant with light experimental work, and accustomed to handling help. Address Box 429, Am. M.

NEW YORK.

First-cass machinist wanted on automobile experimental work. Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Three good draftsmen, familiar with engine or compressor work. Ingersoll-Rand Co., Tarrytown, N. Y.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Wanted—We have openings for a few electrical and mechanical draftsmen. State age, experience and salary expected. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted — Competent correspondence and order clerk by large manufacturer of firearms; must have had good experience in this line; give experience in detail, references, age and salary expected. Box 450, Am. Machinist.

Wanted—Factory store-keeper; must be energetic and familiar with all supplies and materials used in the manufacture of firearms. Give detailed experience, age, references and salary expected. Box 449, Am. M.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hours work day; time and a half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, American Machinist.

Unusual opportunity for young man of mechanical ability to work into a position of responsibility. Must be energetic, tactful and a good executive. Plant located in Country town in South. Reply, giving full experience, present occupation and salary desired. Opportunity, Box 2073, N. Y. Post Office.

Casualty Insurance Company invites applications from practical mechanics, competent to make inspection of the physical condition of manufacturing plants, examination of machinery, inspection of boilers or elevators; must have good appearance and considerable experience with machinery generally; state age, references, past employment and salary expected. Box 442, Am. M.

OHIO.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 455, American Machinist

Toolmakers — Experienced on compound punch and die work. Best of wages to first-class men. Steady work. Address Box 432, American Machinist

Wanted—Foreman to take charge of 20 men making jigs and small tools. One who has had similar position. Address The Cincinnati Milling Machine Co., Cincinnati, Ohio.

Wanted—Mechanical engineer and draftsman. For designing machines (small and medium), jigs and fixtures for rapid production. Must have at least 10 years' experience. Steady employment; good salary. Give age, detailed experience and salary expected. Box 413, American Machinist.

Wanted—First-class man to take charge of designing of up-to-date jigs and fixtures for machine-tool work. Must be capable of giving instructions in use of the same. None but parties having practical shop experience need apply. State experience and salary wanted. Address Cincinnati Milling Machine Co., Cincinnati, O.

PENNSYLVANIA.

Wanted—Good toolmakers and machinsts, familiar with Government work. Box 451, American Machinist.

Wanted — Draftsman and engineer on hoisting engines and air compressors. Box 448, American Machinist.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections, these qualifications carry most weight; character, common sense, experience with automatic machinery, (or) printing-office experience, or type foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Penn.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA.

Wanted—Accurate machinist on Marine Engine work. Ward Engineering Works, Charleston, W. Va.

WISCONSIN.

As the result of doubling its new West Allis Plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Wanted—An experienced tool maker and jig maker, capable of designing jigs for engine work. Give age, experience, reference and salary expected. Address Box 443, Am. M.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, Am M.

WEST OF MISSISSIPPI.

Wanted—Die setter to take charge of bolt threading department of 75 M per day. Box 428, American Machinist.

Wanted—Three first-class Gisholt Turret operators; also twelve machinists. Weber Gas and Gasoline Engine Co., Kansas City, Mo.

Wanted thoroughly up-to-date foundry foreman; also first-class pattern maker; state salary, experience; also references; write Box 430, American Machinist.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co.....116
Acme Machinery Co..... 34
Adams Co..... 9
Advance Mfg. Co.....100
Albro-Clem Elevator Co.....117
Alliance Machine Co.....124
Almond Mfg. Co., T. R.....122
Alteneder & Sons, Theo.... 34
American Gas Furnace Co.. 14
American Pulley Co.....120
American School of Correspondence,
87, 101, 103, 104, 106 and 110
American Tool Works Co.... 8
American Tube & Stamping Co 115
American Watch Tool Co.... 26
Armstrong Bros Tool Co., 96 and 100
Athol Machine Co.....104
Auburn Ball Bearing Co....100
Audel & Co., Theo.....121
Automatc Machine Co.....120

Backus Water Motor Co....102
Baker Bros.....105
Baker Machine Corp..... 94
Baird Machinery Co..... 93
Baldwin Chain & Mfg. Co...103
Baldwin Steel Co. 85
Barker & Co., Wm.....106
Barnes Co., B. F.....115
Barnes Co., W. F. & John....' 14
Barnett Co., G. & H..4th cover
Bartlett, E. E..... 90
Bath Grinder Co..... 91
Baush Mch. Tool Co..... 88
Bay State Stamping Co.....101
Bay State Tap & Die Co.....118
Bay State Tool Co. 113
Beaman & Smith Co..15 and 122

PAGE

Becker-Brainard Milling Machine Co..... 23
Bemis & Call Hdware & Tool Co. 123
Bertram & Sons Co., John.. 27
Besly & Co., Chas. H.....113
Bethehem Fdry. & Mach. Co.. 96
Betts Machine Co..... 6
Bickford Drill & Tool Co ... 10
Bignali & Keeler Mfg. Co... 94
Bilgram, Hugo..... 34
Billings & Spencer Co.....104
Binsse Mach. Co..... 34
Birdsboro Steel Fdry & Mach Co 77
Blaisdell Machinery Co.....106
Blanchard Machine Co..... 34
Bliss Co., E. W..... 25
Blount Co., J. G..... 26
Boker & Co., Hermann..... 83
Boston Gear Works.....118
Boynton & Plummer.....101
Bowers, E. J. 27
Bradford Machine Tool Co.. 5
Brickner Machine Co.....104
Brideport Safety Emery Wheel Co 116
Bristol Co.....4th cover
Brown Co., H. B.....123
Brown-Cochran Co.....102
Brown & Co., R. H.....122
Brown Hoisting Machine Co.125
Brown & Sharpe Mfg. Co., 4th cover and 73
Buckeye Engine Co. 97
Buffalo Forge Co.....4th cover
Builders Iron Fdry....3d cover
Bullard Auto Wrench Co....117
Bullard Machine Tool Co.... 32
Bury Compressor Co.....106
Butler, A. G.....106

PAGE

Caldwell & Son Co., H. W...119
Carborundum Co..... 20
Card Mfg. Co., S. W..... 17
Carpenter Tap & Die Co., J. M..... 97
Case Mfg. Co.....94 and 124
C & C Electric Co.....108
Chadwick & Co., G. B....124
Chambersburg Engr. Co..... 95
Champion Tool Works..... 90
Chattanooga Machinery Co..117
Chicago Flexible Shaft Co.. 31
Chicago Rawhide Mfg. Co..117
Chisholm & Moore Mfg. Co..124
Cincinnati Electrical Tool Co..117
Cincinnati Machine Tool Co.. 24
Cincinnati Milling Mach. Co., 7
Cincinnati Planer Co..... 9
Cincinnati Shaper Co.....126
Clark Cast Steel Cement Co.. 96
Clayton Air Compressor Wks.106
Cleveland Automatic Mch. Co 18
Cleveland Cap Screw Co..... 90
Cleveland Crane & Car Co..124
Cleveland Twist Drill Co., 4th cover
Clough, R. M.....93 and 119
Coates Clipper Mfg. Co..... 97
Coes Wrench Co..... 25
Colburn Machine Tool Co.... 22
Columbus Machine Co.....102
Cook Co., Asa S..... 94
Crescent Forgings Co.....107
Cresson Co., Geo. V.....123
Crocker-Wheeler Co.....111
Crosby Steam Gage & Valve Co. 17
Crowe Name Plate & Engraving Co..... 96
Cumberland Steel Co..... 93
Curtis & Co. Mfg. Co.....106

PAGE

Curtis & Curtis Co.....114
Cushman Chuck Co.....122

Davis, Rodney.....118
Davis Machine Co., W. P.... 92
Desmond-Stephan Mfg. Co...116
Detrick & Harvey Mach. Co 87
Dexter Chas. S.....106
Diamond Machine Co..3rd cover
Dickinson, Thomas L.....117
Diehl Mfg. Co.....110
Dill Machine Works, T. C., 27 and 92
Dixon Crucible Co., Joseph..103
Dodge & Day..... 97
D'Olier, Jr., Co., Henry.... 28
Dreses Machine Tool Co.... 79
Drucklieb, C.....106
Durbrow & Hearne Mfg. Co.. 97

Earle Gear & Mach. Co.....118
Eastern Machinery Co.....124
Eberhardt Bros. Machine Co.110
Eck Dynamo & Motor Works.110
Elliott Chemical Works.... 95
Emmert Mfg. Co.....104
Equipoise Rivet Co..... 98
Errington, F. A.....123
Evans Friction Cone Co....110
Excelsior Needle Co.....114

Fairbanks Co..... 93
Farrel Fdry. & Mach. Co.... 97
Fawcus Mach Co.....118
Fellows Gear Shaper Co....118
Felton, Sibley & Co..... 94
Fenn-Sadler Machine Co.....125
Firth Sterling Steel Co.....115
Fitchburg Machine Works.. 31
Foos Gas Engine Co.....102
Fosdick Machine Tool Co.... 16
Franklin Mfg. Co., H. H....113

PAGE

Frasse Co., Peter A.....114
Frevert Machinery Co..... 94

Galt, Ontario..... 20
Gang Co., Wm. E..... 97
Ganschow, Wm.....119
Gardner Engineering Co.....117
Gardner Machine Co.....116
Garvin Machine Co. 86
General Electric Co.....108
General Pneumatic Tool Co.. 90
Geometric Tool Co..... 29
Gilmore Electric Co..... 28
Gleason Works.....4th cover
Gisholt Machine Co..... 22
Goldschmidt Thermit Co....114
Goodell-Pratt Co..... 94
Gorton Machine Co., Geo.... 95
Gould & Eberhardt..... 99
Graham Mfg. Co.....104
Grant Gear Works.....118
Gray Co., G. A..... 34
Greaves, Klusman & Co..... 97
Greendale Gas Engine Co....102
Greenfield Steam Engine Works 92
Greenwald Co., I. & E.....118

Hamlin, Geo. R..... 90
Hammacher, Schlemmer & Co.79
Hamelle, Henry..... 95
Hampden Corundum Wheel Co 116
Harrington Son & Co., Edw..112
Hart Mfg. Co.....100
Hartford Steam Boiler Insp. & Ins. Co.....102
Hendey Machine Co..... 81
Henley Publishing Co., N. W. 87
Henry & Wright Mfg. Co....103
Heppenstall Forge & Knife Co 96
Hess-Bright Mfg. Co..... 99
High Duty Saw & Tool Co... 75
Hill, Clarke & Co..... 93
Hisey-Wolf Machine Co....121
Hoefer Mfg. Co..... 14
Horsburgh & Scott Co..4th cover
Horton & Son Co., E.....122
Hunt Co., C. W.....124
Hunt & Co., Robt. W.....100
Hurlbut-Rogers Machine Co..126
Hyatt Roller Bearing Co.... 96

Independent Pneumatic Tool Co 105
Ingersoll Milling Machine Co.103
Ingersoll-Rand Co.....107
International High-Speed Steel Co. 114
International Specialty Co..116
Iroquois Machine Co.....116

Jacobs Mfg. Co. 122
Jacobson Mach. Mfg. Co....102
James, D. O.....118
Jantz & Leist Electric Co....110
Jeffrey Mfg. Co. The..... 92

PAGE

Jenkins Brothers.....103
Johnson Machine Co., Carlyle.105
Jones & Co., B. M.....114
Jones & Lamson Machine Co. 12, 13 and 34
Kelly Machine Co., R. A.... 99
Kelly, P. J.....122
Kent & Co., Edwin R.....114
Keuffel & Esser Co 97
King Machine Tool Co..... 94

Landis Machine Co. 104
Landis Tool Co..... 1
Lapointe Machine Tool Co.. 92
LeBlond Machine Tool Co., R. K.....4th cover and 16
LeCount, Wm. G.....122
Link-Belt Engineering Co.... 88
Lodge & Shipley Machine Tool Co 4
Long & Allstatter Co., The.. 87
Lumen Bearing Co..... 95
Lunkenheimer Co., The.....103
Lyon Metallic Mfg. Co...95 & 98

Main Belting Co..... 99
Maris Bros.....124
Marshall & Huschart Mach. Co. 93
Massachusetts Saw Works.. 96
Matchless Cigar Lighter Mfg. Co. 98
McCabe, J. J..92, 93, 94 and 123
McGeorge Mfg. Co.....101
Merrell Mfg. Co..... 95
Merrill Bros.....104
Merritt & Co..... 95
Mfg. Equipment & Eng. Co..120
Mietz, A.....102
Miner & Peck Mfg. Co..... 96
Modern Machinery Daily News 96
Modern Tool Co..... 96
Moore Co., Franklin.124 and 125
Morris Foundry Co., John B.. 15
Morse Chain Co.....109
Morse Twist Drill & Machine Co. 33
Morton Mfg. Co.....123
Motch & Merryweather Mch. Co. 93
Mueller Machine Tool Co....123
Mumford Co., E. H.....121
Mutual Machine Co.....117

National Acme Mfg. Co.....126
National Corundum WheelCo.116
National Separator & Machine Co. 98
Nazel Engineering & Machine Works 104
New Britain Machine Co....112
New Era Gas Engine Co....102
New Haven Mfg. Co.....117
New Machine Co.....117
New Process Raw Hide Co...119
Newton Machine Tool Works. 11
Nicholson File Co..... 17

PAGE

Nicholson & Co., W. H.....121
Niles-Bement-Pond Company, 92, 127, 128, 129 and 130
Nolte Brass Co.....103
Northern Electrical Mfg. Co.111
Northern Engineering Works.124
Norton Emery Wheel Co.... 85
Norton Grinding Co..... 30
Nuttall Co., R. D.....118
Nutter, Barnes & Co.....100

Obermayer Co., S..... 95
O. K. Tool Holder Co.....117
Olds Gas Power Co.....102
Omega Steel & Tool Co.....114
Owen Machine Tool Co..... 22

Parker Co., Chas.....105
Patterson, Gottfried & Hunter, Ltd.....112
Pawling & Harnischfeger....124
Paxson Co., J. W..... 96
Philadelphia Bourse..... 24
Philadelphia Gear Works....118
Phillips-Lafitte Co.....104
Phosphor Bronze Smelting Co.103
Poole Co., J. Morton..... 27
Potter & Johnston Mach. Co. 81
Pratt Chuck Co.....122
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co.. 92

Ransom Mfg. Co.....116
Reece Co., E. F.....125
Reed Mfg. Co.....104
Reeves Pulley Co..... 25
Reichhelm & Co., E. P., 4th cover
Rich, J. & G..... 97
Ridgway Dynamo & Engine Co. 110
Rivett Dock Company..3rd cover
Rivett Lathe Mfg. Co..3rd cover
Roth Bros.....110
Rockford Machine Tool Co.. 20
Rockwood Mfg. Co.....125
Rogers Works, John M..... 33
Rowbottom Machine Co....116
Royersford Fdry. & Mch. Co.. 87

Safety Emery Wheel Co.....116
Sames, C. M.....100
Saunders Sons, D..... 97
Sawyer Gear Works.....118
Schieren & Co., Chas. A.... 87
Schumacher & Boye..... 9
Schwerdtle Stamp Co..... 97
Scranton & Co.....114
Sebastian Lathe Co..... 24
Sellers & Co., Wm..... 21
Seneca Falls Mfg. Co.....101
Shaw & Co.....104
Shepard Lathe Co..... 98
Shultz Belting Co..... 87
Sibley Machine Tool Co.... 87
Simonds Mfg. Co..... 97
Skinner Chuck Co.....122
Sloan & Chace Mfg. Co..... 34
Slocomb Co., J. T..... 91

PAGE

Smith & Mills..... 87
Speed Changing Pulley Co.. 90
Spicer Universal Joint Mfg. Co 120
Sprague Electric Co.....109
Springfield Machine Tool Co. 26
Standard Connecting Rod Co.102
Standard Engineering Works. 96
Standard Gauge Steel Co....117
Standard Machinery Co....123
Standard Tool Co..... 33
Stanley G. I. Elec. Mfg. Co..111
Stark Tool Co.....119
Starrett Co., L. S..... 29
Steptoe Shaper Co., John... 96
Stevens, F. B..... 95
Stoever Foundry & Mfg. Co... 96
Straley & Hasbrouck..... 95
Struthers-Wells Co.....102
Sturtevant Co., B. F..... 27
Switchboard Equipment Co..109

Tabor Mfg. Co.....120
Taylor-Wilson Mfg. Co.....119
Three Rivers Tool Co.....114
Toomey, Frank..... 94
Triumph Electric Co., ...110
Trump Bros. Machine Co.... 94
Turner Brass Works..... 96

Union Twist Drill Co..... 77
United Eng. & Foundry Co..112
U. S. Watch Tool Co.....104

VanDorn & Dutton Co.....118
Van Dyck Churchill Co..... 30
Vitrified Wheel Co.....117

Wallace Supply Co.....103
Waltham Machine Works.... 92
Waltham Watch Tool Co.... 86
Ward & Sons, Edgar T., 33 and 114
Warner Instrument Co.....114
Warner & Swasey Co..... 75
Waterbury Farrel Foundry & Mach. Co.....101
Watson-Stillman Co.....121
Webster & Perks Tool Co....124
Wells Bros. Co..... 89
West Haven Mfg. Co..4th cover
Westinghouse Elec. & Mfg. Co.109
Westmacott Co., J. M.....122
Whitcomb-Blaisdell Machine Tool Co..... 19
Whitman & Barnes Mfg. Co.. 99
Whitney Mfg. Co..... 71
Whiton Mach. Co., D. E.....122
Wiley & Russell Mfg. Co.....110
Wiley & Sons, John..... 34
Wilmarth & Morman Co..... 98
Windsor Machine Co..... 96
Wood's Sons Co., T. B.....125
Woodward & Powell Planer Co. 106
Worcester Mach. Screw Co..104
Wormer Machinery Co., C. C. 94
Wyman & Gordon Co..4th cover

Yale & Towne Mfg. Co.....124

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alloy, Nickel

Boker & Co., Hermann, N. Y.

Arbor Presses

Barnes Co., W. F & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects

Dodge & Day, Philadephia, Pa.

Auctioneers

Shaw & Co., New York.

Automatic Machinery

Matchless Cigar Lighter Mfg. Co., New York.
Natl. Machinery Co., Tiffin, Ohio.

Ball Bearings

See Roller Bearings

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Bars, Boring Cylinder

Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Cling-Surface Co., Buffalo, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather

Davis Machine Co., W. P., Rochester, N. Y.
Main Belting Co., Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Natl. Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain

See Hoists Hand.

Blowers

Am. Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Buckeye Engine Co., Salem, O.
General Electric Co., New York.
Keuffel & Esser Co., New York.

Boilers

Davis Machine Co., W. P., Rochester, N. Y.
Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., Easthampton, Conn.

Bolt and Nut Machinery —*Continued.*
Davis Machine Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Foote, Burt & Co., Cleveland, O.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Natl. Machinery Co., Tiffin, O.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co, Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.

Boring and Turning Mills —*Continued.*
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brazing Plates
Phillips-Laffitte Co., Phila., Pa.

Bulldozers
Natl. Machinery Co., Tiffin, Ohio.
Prentiss Tool & Supply Co., New York.

Burners, Oil
Tate, Jones & Co., Pittsburg, Pa.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Aluminum
Niagara Falls Brass Works, Niagara Falls, N. Y.

Castings, Brass and Bronze
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.
Witteman & Co., A. P., Philadelphia, Pa.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.

Chains, Driving—*Continued.*
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Davis Machine Co., W. P., Rochester, N. Y.
Gisholt Mach. Co., Madison, Wis.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Gottfried & Hunter, Ltd., N. Y.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compounds, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compounds, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cresson Co., Geo. V., Phila., Pa.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter Ltd., New York.

CHAIN DEPARTMENT

Roller Chains Block Chains
"Wizard" Chains.

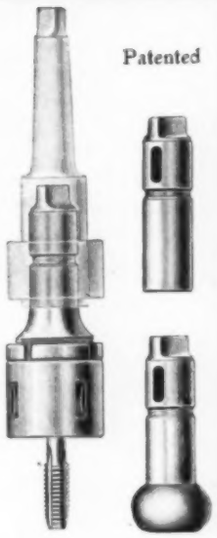
MACHINE DEPARTMENT

Hand and Weight (feed) Milling Machines,
20-inch Water Tool Grinders.

MISCELLANEOUS DEPARTMENT.

Keys and Cutters for the Woodruff Patent System of Keying
"Presto" Chucks, Collets and Friction Tapping Devices
Sprockets for "Wizard" Chains
Hartford Printer.

"Presto" Chucks, Collets and Friction Tapping Devices are used in Drill Presses, Turret Machines and Lathes and they make possible the rapid change of Drills, Reamers, Counterbores, Taps, etc., without stopping the spindle of the machine.



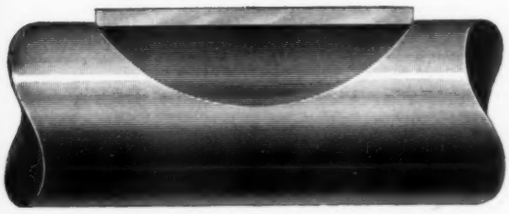
Patented

Detachable Type

Patented

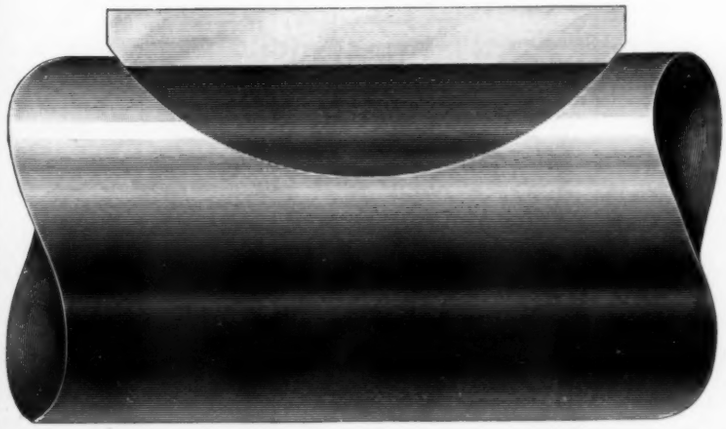
Against claims made by Competitors, we submit the following list of Motor Car Manufacturers using "WHITNEY" ROLLER CHAINS and STANDARDS. Is it not time for everyone to admit that "WHITNEY" STANDARDS for ROLLER CHAIN dimensions are now the American Standards?

"ADAMS-FARWELL" "AMERICAN MOTOR TRUCK" "AUTO-CAR EQUIPMENT" "BAKER" "BERKSHIRE" "BIDDLE-MURRAY" "CADILLAC" "COLUMBIA" "CHAMPION (McCrea)" "CROWN" "CRAWFORD" "COLUMBUS BUGGY CO." "ELWELL-PARKER" "FORD" "FRANKLIN" "GAETH" "GALE" "GROUT" "HEWITT" "THE HOLMES" "IROQUOIS IRON WORKS" "LAMBERT" "KNOX" "MATHESON" "MACK BROTHERS" "MITCHELL" "MOLINE" "NEW YORK MOTOR TRUCK" "OLDS" "PACKARD" "RAMBLER" "RAPID" "REO" "STEARNS" "THOMAS" "TOURIST" "VECHICLE-EQUIPMENT" "WAYNE" "WESTERN MOTOR TRUCK" "WINDSOR" etc.



The "Woodruff" System is more mechanical, more efficient, and also a great Labor Saver.

The "WOODRUFF" Patent System of Keying



has been adopted by the Leading Manufacturers of Machinery, Automobiles, etc.

THE

WHITNEY MFG. CO.

Hartford, Conn., U. S. A.

Couplings, Shaft—*Continued.*
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.
Witteman & Co., A. P., Phila., Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co. Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.

Cutting Machines—*Continued.*
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.
Swaine Co., Fred J., St. Louis, Mo.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Foote, Burt & Co., Cleveland, Ohio.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Obermayer Co., S., Cincinnati, O.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.

Drilling Machines, Multiple Spindle—*Continued.*
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., Ohio.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I., Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F. Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
D'Olier & Co., H., Phila., Pa.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I., Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. Co., Chicago, Ill.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.

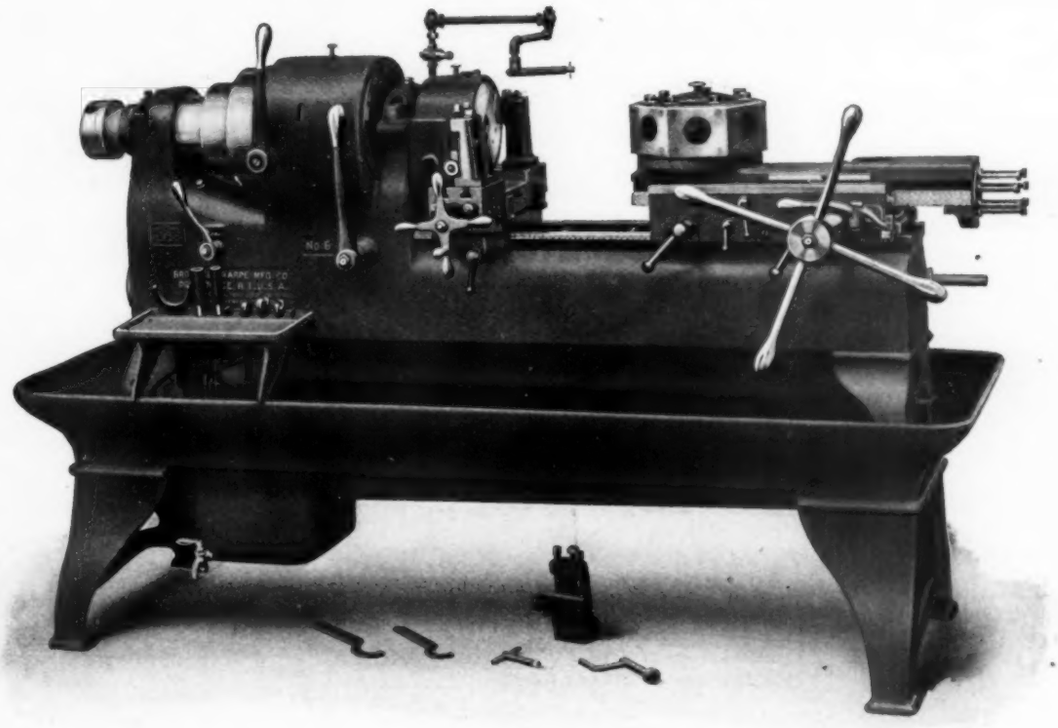
NO INTRICATE MECHANISM.

Simple and Effective in Design.

A B. & S. No. 6

WIRE FEED SCREW MACHINE

is readily understood and easily operated.



Independent stops are provided for each hole in the turret. They are conveniently located and easily adjusted.

The turret slide has transverse and vertical adjustments by which it can be kept accurately in line with the spindle.

The chuck is operated by a lever on the front of the machine. It is adjustable to a wide range of sizes and automatically compensates for ordinary variations in size of stock.

WRITE FOR A CIRCULAR DESCRIBING THE MACHINE.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical

Dodge & Day, Philadelphia, Pa.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Bowers, E. J., Philadelphia, Pa.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Greendale Gas Engine Co., Worcester, Mass.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil

Mietz, August, New York.

Engines, Steam

Buckeye Engine Co., Salem, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube

Nicholson & Co., W. H., Wilkesbarre, Pa.

Fans Electric

Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Fenthers

Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines

Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Foreign Agencies

Hamelle, H., Paris, France.

Forges

Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Natl. Machinery Co., Tiffin, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Baldwin Steel Co., New York.
Boker & Co., Hermann, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Witteman & Co., A. P., Philadelphia, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cncinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers

Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering

Amercian Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling

American Gas Furnace Co., N. Y.

Furnaces, Forge

Witteman & Co., A. P., Philadelphia, Pa.

Furnaces, Gas

Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Oberamyer Co., S., Cincinnati, O.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., New York.

Furnaces, Oil

Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Tempering

Witteman & Co., A. P., Philadelphia, Pa.

Furniture, Machine Shop

Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters

Sturtevant Co., B. F., Boston, Mass.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam

Davis Machine Co., W. P., Rochester, N. Y.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Matchless Cigar Lighter Mfg. Co., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sloan & Chace Mfg. Co., Newark, N. J.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
James, D. O., Chicago, Ill
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Mfg. Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
VanDorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide

Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., The, Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
James, D. O., Chicago, Ill.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
VanDorn & Dutton, Cleveland, Ohio.
Walcott & Son, Geo. D., Jackson, Mich.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Rivett-Dock Co., Boston, Mass.

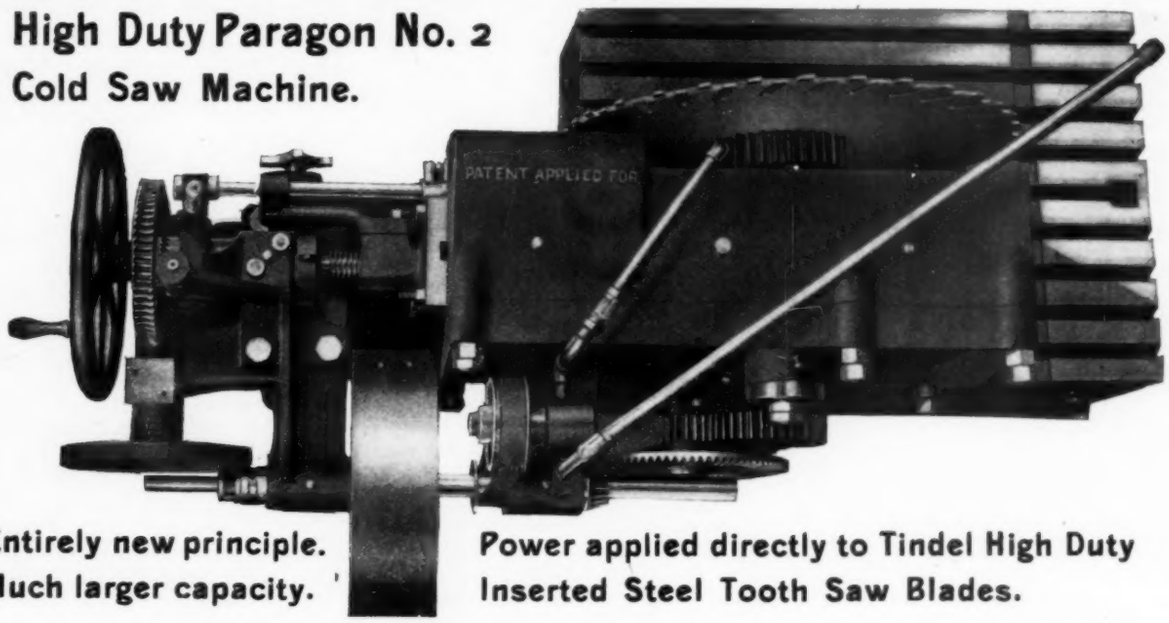
Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, Ohio.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Machine & Tool Works, Dayton, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., New York.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

High Duty Paragon No. 2
Cold Saw Machine.



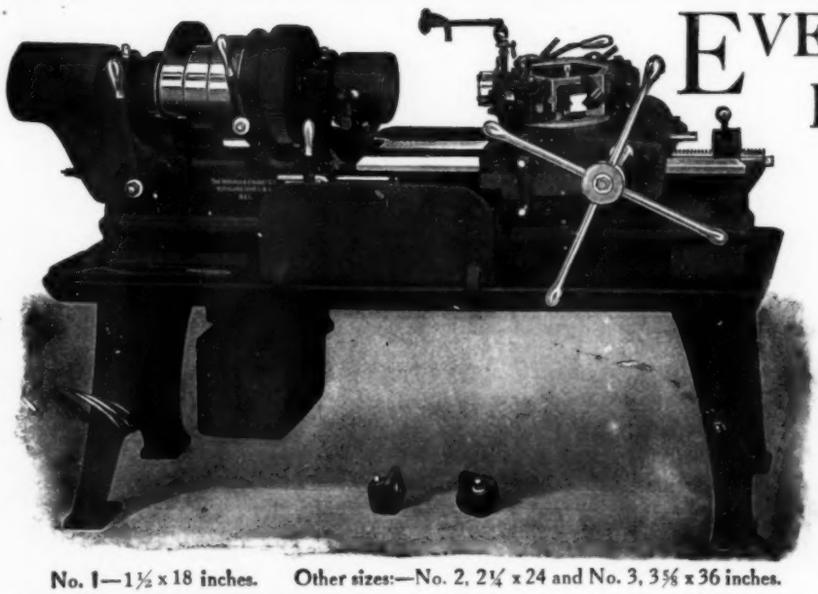
Entirely new principle.
Much larger capacity.

Power applied directly to Tindel High Duty Inserted Steel Tooth Saw Blades.

38 reductions in power between belt and saw blades. Feeds an inch or more a minute through steel. Impossible for saw to buckle as there is no push or compression in the blade. Has no worm or worm wheel to waste power by useless friction. Carriage completely enclosed runs in oil bath. All bearings are phosphor bronze. Cuts up to 9" diameter and cuts a lot off the cutting cost.

GET FULL PARTICULARS.

High Duty Saw & Tool Company **Eddystone, Penna.**



No. 1—1½ x 18 inches. Other sizes:—No. 2, 2¼ x 24 and No. 3, 3⅝ x 36 inches.

EVERY SIZE MOST ECONOMICAL for work strictly within its range

No. 1 Hollow Hexagon Turret Lathe, here illustrated, for small work—1⅝" diameter and smaller in lengths up to 18"—greatest rapidity and ease in operation—GREATEST OUTPUT.

Larger machines for larger work.

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Turret Lathes and Brass-Working Machine Tools.

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Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Patterson Tool & Supply Co., Dayton, Ohio.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Thompson Grinder Co., Springfield, O.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mch. Co., Worcester, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnat, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Co., Worcester, Mass.

Grinding and Polishing Machines—*Continued.*
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Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harringotn, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneumatic Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, Ohio.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Royersford Fdry. & Machine Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Thompson Grinder Co., Springfield, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinding Wheels
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, N. Y.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Pneu. Tool Co,, Cleveland, O.
Dayton Pneumatic Tool Co., Dayton, Ohio.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power
Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Chicago Flexible Shaft Co., Chicago, Ill.

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Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mchry. Co., Cleveland, O.
Case Mfg. Co., Columbus, Ohio.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Main Belting Co., Phila., Pa.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric
C & C Electric Co., New York.
Case Mfg. Co., Columbus, Ohio.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Case Manufacturing Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Frevert Machinery Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg.. Co., New York.

Hoists, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel
Sprague Elec. Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Test
Equipoise Rivet Co., Waterbury, Conn.
Norton Emery Wheel Co., Worcester, Mass.
Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Davis Machine Co., W. P., Rochester, N. Y.
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenhemer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Clark Cast Steel Cement Co., Shelton. Conn.
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Mdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda
Mfg. Equip. & Engrg. Co., E. Boston, Mass.

Key Seaters
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Machine Tool Co., W. P., Rochester, N. Y.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear
Phillips-Laffitte Co., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bowers, E. J., Philadelphia, Pa.
Bradford Machine Tool Co., Cincinnati, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
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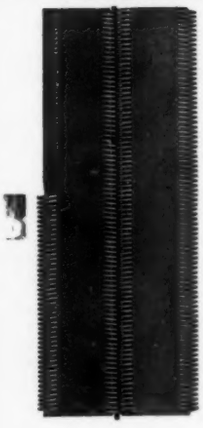

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Seneca Falls Mfg. Co., Seneca Falls, N. Y..
Sloan & Chace Mfg. Co., Newark, N. J.

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Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Amercian Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barker & Co., Wm., Cincinnati, Ohio.
Barnes Co., W. F., & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Champion Tool Works Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Providence, R. I.
Dreses Mach. Tool Co., Cincinnati, O.
Fairbanks Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayon, Ohio.
Prentiss Tool & Suply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Wells & Sons, Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Patterson, Gottfried & Hunter, Ltd,, New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Lathes, Brass
Barker & Co., Wm., Cincinnati O.
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Speed
Blount Co., J. G., Everett, Mass.

Lathes, Wood
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., New York.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Electric
General Electric Co., New York.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Cleveland, O.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mach. Co., C. C., Detroit, Mich.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, Ohio.
Hammacher, Schlemmer & Co., New York.
LeCount, Wm. G., So. Norwalk, Conn.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
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Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
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Machinists' Supplies
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Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co., Cincinnati, Ohio.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

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Advance Mfg. Co., Kalamazoo, Mich.
Besly & Co., Chas. H., Chicago, Ill.
Lumen Bearing Co., Buffalo, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Meters, Electric
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Milling Machine Co., Cincinnati, O.
Hendey Mch. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill, Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin. O.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Horizontal—*Continued.*
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Watlham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Milling Mach. Co., Rockford, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Rand Co., New York.

Mixing and Sifting Machines, Sand
Gould & Eberhardt, Newark, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Mumford Co., The E. H., Philadelphia, Pa.
Tabor Mfg. Co., Philadephia, Pa.
Webster & Perks Tool Co., Springfield, O.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

Motors, Electric
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
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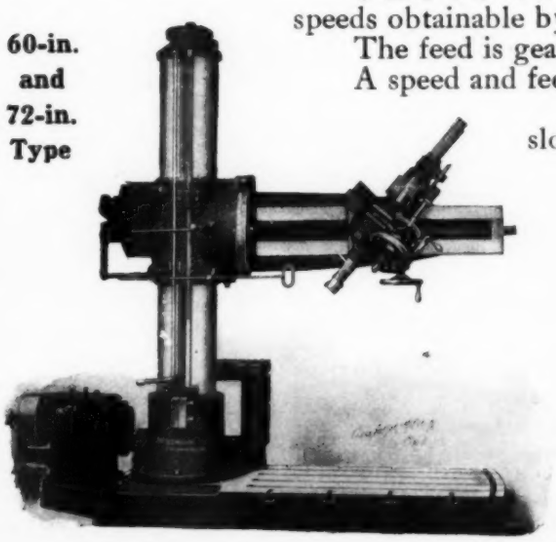

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Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Franklin Mfg. Co., Syracuse, N. Y.
Turner Brass Works, Chicago, Ill.

Nut Tappers

See Bolt and Nut Machinery

Oil Cups and Covers

Davis Machine Co., W. P., Rochester, N. Y.

Oil Stones

Norton Emery Wheel Co., Worcester, Mass.
Pike Mfg. Co., Pike Station, N. H.

Packing, Metallic

Advance Mfg. Co., Kalamazoo, Mich.

Packing, Steam

Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic

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Felton, Sibley & Co., Phila. Pa.

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Lyon Metallic Mfg. Co., Chicago, Ill.
New Britain Mach. Co., New Britain, Conn.

Pans, Shop

Lyon Metallic Mfg. Co., Chicago, Ill.
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Rowbottom Machine Co., Waterbury, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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Phosphor Bronze Smelting Co., Philadelphia, Pa.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
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Saunders' Sons, D., Yonkers, N. Y.
Standard Engineering Works, Ellwood City, Pa.
Stoever Fdry. & Mfg. Co., Myerstown, Pa.
United Engineering & Fdry. Co., Pitsburg, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Saunders Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

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Gray Co., G. A., Cincinnati, O.

Planers

American Tool Wks., Co., Cin., O.
Bartlett, E. E., Boston, Mass.

Planers—*Continued.*

Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bligram, Hugo, Philadelphia, Pa.
Cincinnati Planer Co., Cincin., O.
Cleveland Planer Works, Cleveland, O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co,, New York.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable

Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Powders, Tempering and Welding

Phillips-Laffitte Co., Phila., Pa.

Precision Machinery

American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Broaching

Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Presses, Drop

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Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Swaine Co., Fred J., St. Louis, Mo.

Presses, Foot and Hand

Bliss Co., E. W., Brooklyn, N. Y.
Phoenix Iron Works Corp., Hartford, Conn.

Presses, Forging

Niles-Bement-Pond Co., New York.

Presses, Hydraulic

Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Presses, Power

American Tube & Stamping Co., Bridgeport, Conn.
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Davis Machine Co., W. P., Rochester, N. Y.
Dill Machine Works, T. C., Philadelphia, Pa.
Fairbanks Co., New York.
Lucas Mach. Tool Co., Cleve., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Springfield Mach. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Screw

Barnes Co., W. F. & Jno., Rockford, Ill.

Profilers

American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Publishers

Henley Pub. Co., Norman W., New York.

Pulleys

American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Machine Co., W. P., Rochester, N. Y.
Eastern Machinery Co., New Haven, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Rockwood Mfg. Co., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

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American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Pumps, Air

Ingersoll-Rand Co., New York.

Pumps, Electric

General Electric Co., New York.

Pumps, Hydraulic

General Electric Co., New York.
Watson-Stillman Co., New York.

Pumps, Steam

Davis Machine Co., W. P., Rochester, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.

Punches, Hydraulic

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Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.
Watson-Stillman Co., New York.
Prentiss Tool & Supply Co., New York.

Punches, Power

Bertram & Sons Co., Ltd., John Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Bridsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Hamilton, Ohio.
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LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
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Simonds Mfg. Co., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Standard Gauge Steel Co,, Beaver Falls, Pa.
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Clough, R. M., Tolland, Conn.
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Chambersburg Engineering Co., Chambersburg, Pa.

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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
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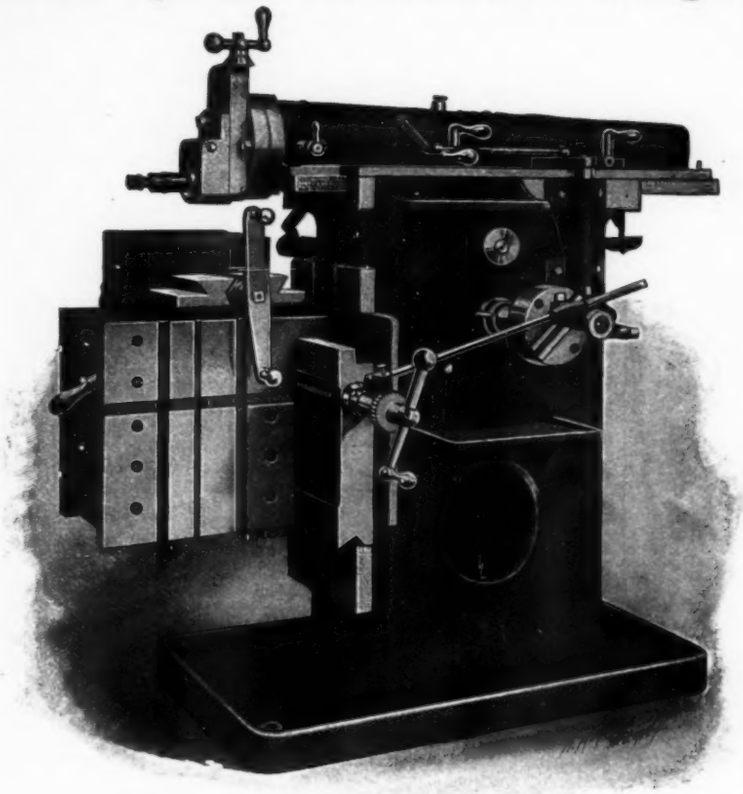

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Micrometer Dial on cross feed screw as well as on down feed.
Taper gib between cross rail and saddle with adjusting screws at either end.
Heavy Crosshead with projected bearing on column, affording ample support to table under long cuts.
It will plane to a line or drilled hole for key way work.
It will take shaft 3¼" diameter directly under ram for key seating.
It has uniform speed full length of stroke.
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It is widely known and used and recommended by good mechanics.
Furnished with solid or adjustable table; round or improved vise.

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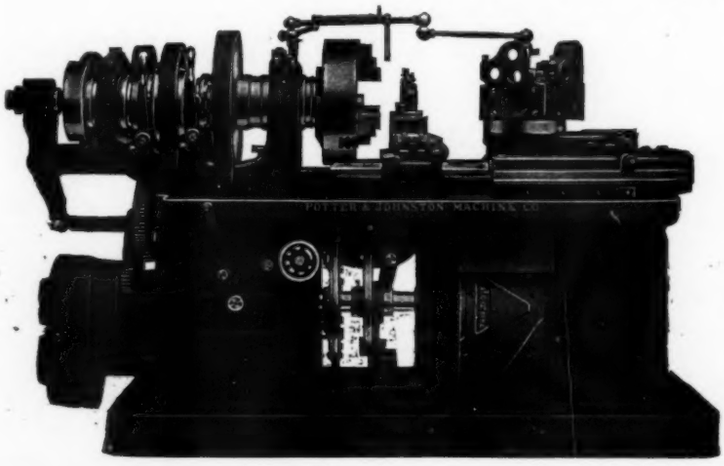

and the work is so conveniently and easily done that it is a pleasure to use it. It is for the finishing of castings of iron, steel or bronze up to 14 in. diam. by 7 in. long or work from the solid bar. All the operator has to do is to keep the machine supplied with work; the machine does the rest. One man can keep from 4 to 8 machines at work.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Wilmington, Del.
Niles-Bement-Pond Co., New York
Prentiss Tool & Supply Co., New York.
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New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
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American Tube & Stamping Co., Bridgeport, Conn.
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Boker & Co., Hermann, New York.
Frasse Co., Peter A., New York.
Firth-Stirling Steel Co., Demmler, Pa.
International High Speed Steel Co., New York.
Jones & Co., B. M., Boston, Mass.
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Standard Gauge Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.
Witteman & Co., A. P., Philadelphia, Pa.

Testing Hacksaws.

As one of the foremen complained, one day, that we were badly in need of some material, now long over due, I stopped to see my friend, the purchasing agent, as I went by his office. After assuring me that "the stuff was on the way," he asked what I knew about hacksaws but did not thank me for telling him that they were thin strips of steel, having teeth on one edge, used for cutting up bar stock. His trouble was to determine the best brand of saws from the large number offered for sale, and he confided to me that sending samples to the man in charge of the "cutting-off room," for him to test, did not, in his opinion, result in the best being selected. On the contrary he had become pretty well convinced that the saws which Pete had always maintained were far superior to any others, because they "were good and tough and did not break so quick," were in reality only fairly efficient. If we could test them in some way, it ought to give us some real information as to their relative values.

After talking it over with him for a few minutes, I agreed to see what could be done in the way of tests if he would furnish me with a dozen or so of each brand that he considered worth experimenting upon. Before I had finished I had reason to be thankful that there were only three or four kinds, as it proved to be a very tiresome job. Not having much time to spend on the work, I decided, after considering the rigging up of some kind of an automatic machine, that it would be just as well, for the present, to obtain the number of strokes of the saw under test required to cut off a given-sized bar, which could be easily done by counting; and then, by plotting a curve from several such observations, to see whether or not there was any decided difference between the different brands. Later, in case it proved that interesting results were obtained, I hoped to devise some sort of machine to make an automatic record which would allow tests to be conducted at various speeds, pressures, etc. However, although somewhat tedious, the method of counting gave all the information that was necessary at that time and an opportunity to carry the experiments further never presented itself.

As Pete, who by the way was not much of a mechanic, was running his fifteen or twenty power hacksaws overtime, until 10 o'clock, every night, I spent the time between supper and bed, for quite a while, in helping him cut up 1½-inch square bessemer steel bar into short lengths. The adjustable weights by which the pressure upon the saws was varied, were all placed in the same relative position, on the machines under test and as the machines were all of the same design, this was assumed to give equal pressures upon the saws. As many machines were operated as could be attended to, sometimes a half-dozen at once. The size of bar and pressure on the saws being the same in all cases, all that needed to be observed was the number of strokes to cut off each piece. In order to get an idea, if possible, as to how rapidly the saws became dull, fifteen pieces or more were cut off with each sample saw.

As it was evidently impossible to count the strokes for more than one machine at once and as counters were not at hand, the time of starting each machine was noted in a table arranged for that purpose, and the noise, when the machine had cut off a piece and attomatically stopped itself, attracted the attention so that the time of stopping could also be noted. The time, if I remember rightly, was read to the nearest quarter of a minute, and the elapsed time multiplied by the number of cutting strokes per minute and again multiplied by the length of the cutting stroke (or forward movement alone) in feet gave the number of cutting feet through which the saw had passed, to cut through 1½-inch square steel or 2.25 square inches of steel. The number of strokes were counted for each saw, every half or three-quarters of an hour, as they varied among themselves and the line-shaft speed was not constant. Generally it was about 58—61 strokes per minute. The length of stroke also varied somewhat due to wear in the wooden connecting rods and was measured for each machine to the nearest ⅛ inch.

The results were plotted as shown in the diagrams, where each vertical line represents one piece cut off or 2.25 square inches through which the saw has passed, or 31.5 square inches for the fourteenth piece. The horizontal lines each represent 100 cutting feet of the saw. As the number of cutting feet of the saw required to cut off one piece was plotted, any increase indicated that the saw was becoming dull and the amount could be readily seen.

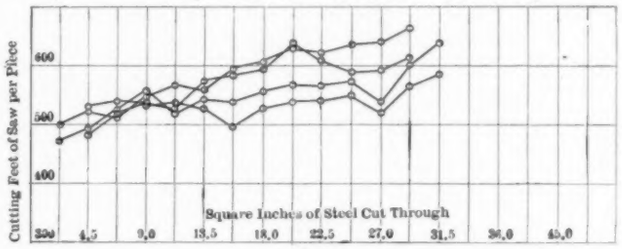


FIG. 1 Saws A.

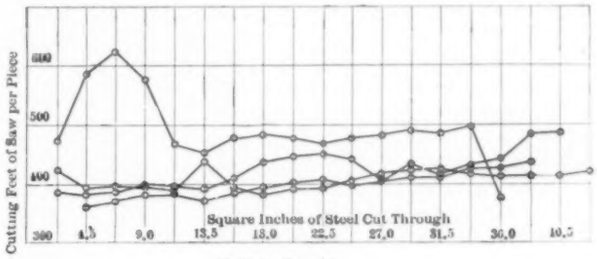


FIG. 2 Saws B

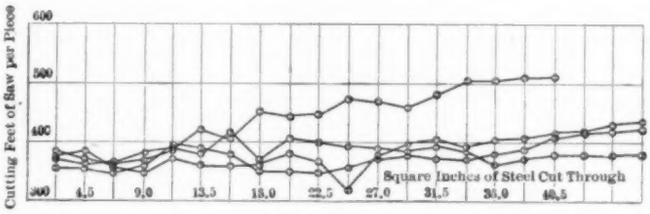


FIG. 3 Saws C

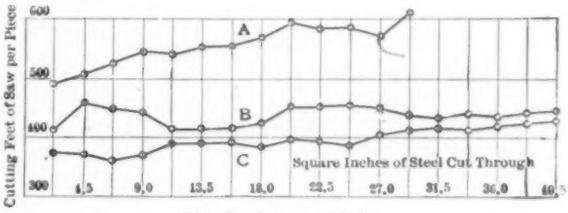


FIG. 4 Average of All Saws

TESTS OF HACKSAWS.

Four samples of each of three brands are given—*A* Fig. 1, *B* Fig. 2, and *C* Fig. 3—also the average for each brand in Fig. 4. While there appears to be a great deal of irregularity in the individual curves, they lie quite closely together, especially the lowest three in Figs. 2 and 3, and the averages show well defined characteristics for each brand. The peak in the highest curve at 6.75 square inches, in Fig. 2, being supported by a point on each side, is probably due to a hard place in the bar. The curve which lies above the others in Figs. 2 and 3, may have been due to those readings having been taken from a machine which put less pressure upon the saw, for some reason, so cutting less rapidly, or to those particular bars being somewhat harder than the others. It should be noted that in Fig. 4, *C*, after 18 pieces, or sawing through 40.5 square inches, required 16 per cent. more time to do the same work than at

first. This was after working for about five hours. *B* only required 10 per cent. more time while *A*, after only 13 pieces or 29.25 square inches, required over 23 per cent. more time than at first, to say nothing of taking 32 per cent. more time than *C* at the start.

In trying to increase the cutting speed by increasing the pressure upon the saws, it was found that the guides between which the blades ran were worn so much as to allow the blades to bend, and the results were anything but satisfactory. Adjusting the guide screws improved matters considerably but it was necessary to lower the saw very carefully upon the work until it had obtained a good bearing in the metal. What was more serious was that many saws caught in the thin metal, just as the bar was cut nearly through and broke. It was to obtain as nearly constant a bearing length in the metal as possible that the square bars were selected instead of round ones.

Pete's objection to the saws *C*, which showed up so well, was that they frequently broke, due to careless handling by his helpers, but it seemed that the saving in time that they effected would cut down the overtime necessary.

It would be interesting to carry experiments further and find the length of useful life, effect of pressure, speed, etc., with some testing machine which would obtain more uniform results. Perhaps very decided advantages would be found for the device which I remember seeing in Mr. Fellows' gear-shaper shop at Springfield, Vermont, some years ago. An ordinary power hacksaw machine was fitted with a special vise to hold the round bar and rotate it slowly under the saw by means of a worm. This would cut off more nearly square and allow the maximum pressure on the saw, once found, to be maintained, as the contact between the saw and the work can not at any time be very great.

Possibly the solution of the whole cutting-off problem, for low cost, is to employ a powerful circular saw having inserted teeth of high-speed steel, such as are so frequently advertised. Hacksaws, when used in power machines, seem to object to being hurried, although they may possibly prove by trial to be the cheapest means of cutting up bar stock.

H. L. WHITTEMORE.

Manchester, England.

A new kind of drawing has been discovered by the daily newspaper reporter, and he found it in connection with the proceedings of some aëronauts, who in getting up flying machines made what the reporter called work-in-drawings, and the headline man has faithfully reproduced this term, so that perhaps it will become current in the art. We surmise, however, that somebody spoke within the hearing of the reporter of "workin' drawin's," and to make it correct he has hyphenated it.

A Crooked Molding Machine Job.

BY F. W. HALL.

In spite of the cost of mounting patterns on molding machines, foundrymen are finding them a paying investment, especially where very crooked patterns are used and large orders are to be had. In some foundries there are over a hundred machines installed, the Western foundries being usually fitted out with hand-ramming machines, while in the Eastern foundries the power machine is more in favor. Each machine has its line of work to which it is best adapted, thus plain straight patterns are most successfully used on the power ramming machine; crooked work has been put mostly on the hand machines, having been considered out of the line of the power machines, but I have in the last few years seen several very crooked patterns mounted and worked successfully on the latter type of machine.

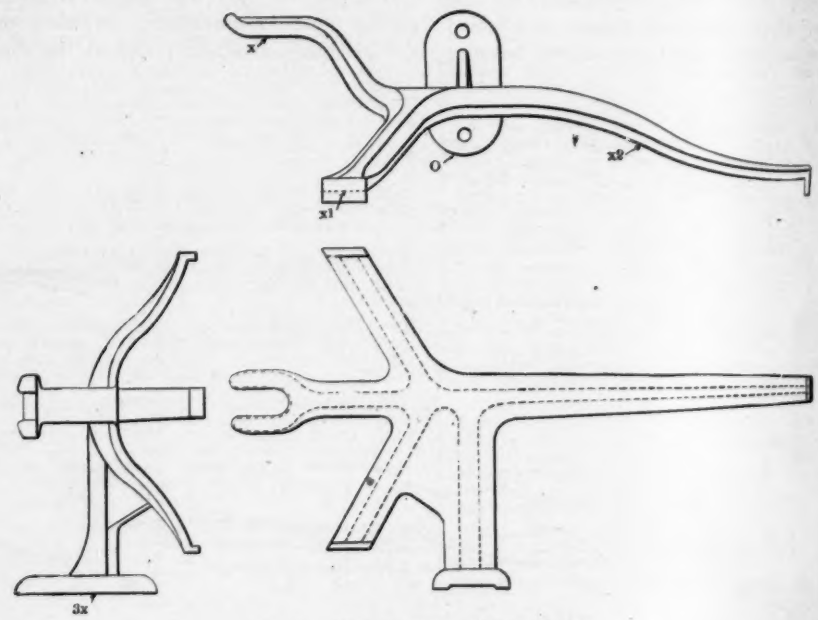


FIG. I. THE CASTING TO BE MADE.

Some of the largest foundries of the country have made a special study of the molding machine and have spent thousands of dollars experimenting with them, until now they have their own make of machines, which, though resembling the one on the market, have special features adapting them to their line of work. Thus, the large loom works in the New England States have adopted the hand-molding machine for the greater part of their work, and when each job is fitted out with a lot of iron flasks and the machine is worked systematically, it has proved very successful and quite rapid. The light hardware foundries have adopted for the most of their work the vibrator frame and the power ramming machine, with satisfactory results. The malleable-iron firms are using a great many hand squeezers, and some have a good many hand ramming machines, with a few power machines. I intend to describe herein a job which I saw mounted on a Paxson-Hall molding machine, which had a very crooked pattern, as can be seen in Fig. 1. It took nine heaping shovels of sand to mold this casting, but the casting weighed only eight pounds; the pattern mounter called it "a big nothing." It had a cast-iron bar in the drag so as to lift it off the machine and turn it over, and the cope had an angle iron in it opposite the foot *O* (Fig. 1) to keep the iron from breaking out when poured. This job was made in a 24x4-inch wood snap flask 6¾-inch cope and 5¼-inch drag, and on the ends of the drag flask on the inside was placed a piece of ¼-inch brass with a V form cut in it for the special bar to set into the V sides, causing the bar to slide in the same location every time, thus facilitating rapidity of setting; the flask was made out of 1⅛-inch maple and the fittings were of a very strong type, making the flask very rigid; the flask was also fitted with special round pins.

SOME DIFFICULTIES MET WITH.

In the mounting of this job on a molding machine the designer of it endeavored to mount it on a narrow molding machine. The consequence was that a narrow flask was used, when made by hand a 16-inch wide flask was used and on the machine a 14-inch was used, thus saving two inches of sand; and by using a narrow machine for this job it became necessary to part the job differently than was done when worked by hand. In Fig. 4 will be seen a sectional view of the pattern showing the parting line of the flask and its relation with the parting line of the pattern, and two inches below this will be seen a line that represents the parting line of the flask when made by hand; so it will readily be seen that when it was made by hand there was no big deep pocket in the drag such as was made on

a narrow molding machine, so of course as no pocket of any size was to be dealt with the job was made easy; but as the pocket was reduced in the drag it caused two small pockets to come opposite each foot *H* Fig. 4. These pockets were not deep enough to bother in the molding of it, but when the job was tried on the machine as shown mounted in the cuts, a great deal of trouble was encountered, especially in the drag in the deep pocket. Stool *K* was made to strip the sand out of the deep pocket, but when mold was turned from the machine to the floor the sand would drop, so soldiers were put in the mold and sometimes these would work and again they would not; anyway they could not be depended on, as the machine operator would get them in one way one time and another way another time. To overcome this an iron bar was made to extend the whole length of the mold and the two brass pieces put in the end of the flask in such a position as to allow the mold and the flask to separate from each other; then all was not clear sailing, for sometimes the sand would break and stick down in the deep pocket, till at last it was discovered that the bar was so constructed so as to cut up the sand in the deep pocket into four parts and thus weaken it, so two of the ears on the side of the bar were cut off and then the sand would lift out without any trouble. The machine operator would use the end of his shovel to tuck around the center bar and in the deep pocket where he did not do much tucking; however, to obviate the necessity for this a conforming board was resorted to and after a while a conforming board was made that would tuck the mold so as to bring it out without any tucking with the shovel, but when the mold was set on the floor it would crack through the center; this was due to the tucker on the conforming board and if the outside edges of the mold could be tucked as hard as the center this cracking could have been overcome, but in this particular job the outside edges could not be tucked any harder, so the conforming board was thrown out and the operator used his shovel handle; being quick he had the tucking done in the length of time that it takes to tell it, so it was called well enough and left alone.

In the making of the cope section of the mold a little trouble was found; the sand would stick down to the sides of the pattern next to the plate and was found afterward; the fault was found in the surface of the pattern, for after this was waxed and rubbed down well it came off all right. With the aid of a little heavier vibration on the pattern, the two highest points of the pattern came so close to the top of the mold as to make the sand pack too hard on the top of it and consequently blow when poured; to overcome this a hole was cut in the cope board directly over the highest points of the pattern, and when the board was lifted off the high point was struck off and out of the way.

It was found necessary to save on the weight of the mold and the amount of sand used, so the corners of the flask were blocked off and when this was done it worked better than ever. It seemed the area of the plates on the corners where it was a perfectly flat surface checked the sand from the uneven section of the plate and made a perfect mold. There were some other points of the pattern and the plate that were changed. These will be taken up and explained as they are met with in the description of the construction of the different plates and the two sections of the patterns (cope and drag).

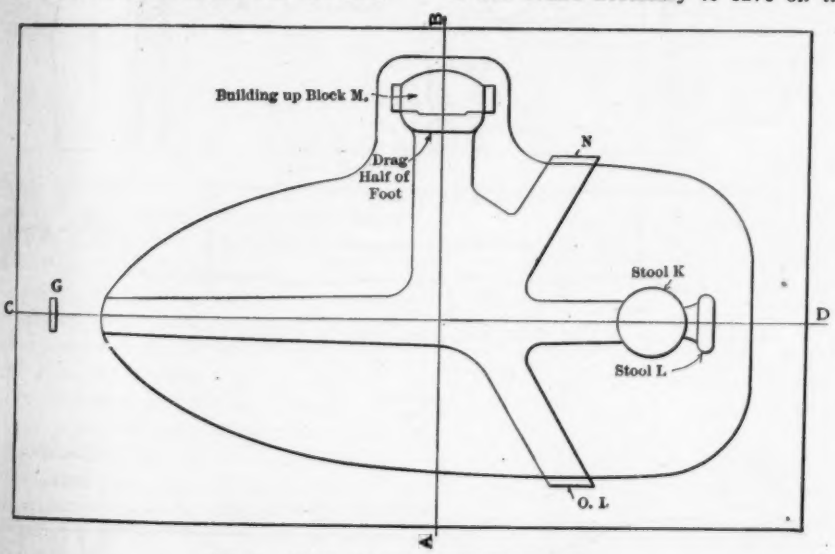


FIG. 2. PLAN OF DRAG PATTERN PLATE.

In the first day or two that this job was worked there were turned out in a day about 28 molds; this made things look bad for a while, but as the difficult points were altered more molds were put up till after a few days 23 molds were put up in one hour, and more could have been put up if the operators desired.

DETERMINING THE PARTING.

In mounting this pattern on a Paxson-Hall machine and working from blueprint as shown in Fig. 1, the mounter had to first determine the parting line, and so the flat on the under side of the pattern was determined as the point. This is designated in Fig. 1 as *X*-1, *X*-2 and *X*-3. From *X*-3 the parting ran around the circular section of the foot of the pattern, and is designated by *O*, so practically all the pattern is made in the cope save the sections *G*, *N* and *O* and half of the foot, as will be seen in Fig. 2 mounted on the drag plate.

THE COPE PATTERN.

The regular pattern plate was used for the cope machine, and the parting line was carried to the shape of the pattern by the use of a building-up block shown in Fig. 5. An end view of it can be seen in Fig. 6 with the cope pattern resting on it; this block was cast hollow, with its walls about ½ inch thick at all parts, save where it was held fast to the plate by screws, and here the metal was a little thicker. Before this building-up block was made the master pattern of the pattern to be made on the machine was made, then the center lines were scribed on top of the pattern plate and also the center lines of the master pattern of the casting; then the exact location of the master pattern was determined; the pattern was tacked to the top of the pattern plate master pattern, bringing the parting on the pattern to the flat top of the pattern plate in the best position for molding, and in doing so making the outline of the block as shown in Fig. 5. The outline of the casting as shown in the building-up block in Fig. 5 represents the flat surface on the top of the block where the pattern is to rest. The width of this flat surface is about three-sixteenths inch more than the flat surface of the pattern; this is for the purpose of bringing the parting of the uneven surface away from the pattern and thus causing no sharp corners to break off the sand mold and fall within the cavity made for the iron to run in. At the face of the foot on the casting of pattern is cast a cavity in the building-up block; this cavity is for the purpose of bringing the parting line around the edge of the foot on the casting of the pattern instead of across the center of the face of the foot, as was first done and afterward changed. All the building-up blocks should have a finish allowed on that face which rests on the pattern plate.

THE DRAG PATTERN.

The drag master pattern was made by making a flat plate to the same thickness as the cope plate. This plate had an opening cut in the center ⅜ inch smaller than the size of the building-up block, then a form was built up and around the cope building-up block, standing away from the building-up block about ⅜ inch and this form tacked to the underside of the

drag pattern plate while in this position, then both of the pattern plates and the master pattern were sent to the iron foundry and a good casting made from each for a pattern.

FITTING THE PERMANENT PATTERN AND PLATES.

Finishing and fitting of the iron pattern and plates to one another and then to the machine was done as follows: First, the pattern plates were planed to fit the molding machine, their top face being planed perfectly true and both plates were made to the same thickness around the edge so as to set on the machine with the top of them flush with the top of the flask frame. The exact location of the building-up block was laid off on the top of the cope pattern plate and then the building-up block was planed on its bottom surface so as to rest level on the plate; then the iron pattern casting was finished to size and fitted to the building-up block and the remainder of the block was finished off smooth and the block and pattern were fastened together by screws and then the block was made fast to the top of the cope pattern plate. The drag pattern plate was taken up and all over the face of the babbitted area was made a series of small holes to allow the babbitt to run in, and on the sides that stood most nearly vertical were inserted several machine screws; then in the lowest section of the cavity in the drag plate were drilled several small holes and one three-eighths-inch hole for babbitt to run into. The pattern of the casting on top of the cope building-up block was removed and the two plates were put together and fastened there firmly, the building-up block sticking down into the cavity of the drag plate; then the two plates were turned so as to bring the drag plate on the top with the pouring holes uppermost, then these plates were slightly heated, just enough to take the chill off them. The hot babbitt was turned into the pouring hole till the cavity was filled in the drag plate; this babbitt forming around the cope-forming block, made a perfect match of it. When the babbitt was set the two plates were separated and the face of the babbitt was dressed till both plates fitted together perfectly, then the cope pattern was set on the top of the cope building-up block; then the small building-up block *H* of Fig. 5 was made out of brass and fitted to the curved end or the surfaces of the ends of the two forks of the pattern. These ends of the forks being separated by about ¾ inch, the curve on their ends is such as to make the building-up block *H* rise about ½ inch above the top of the main building-up block. As whatever is put on the top of the cope block must be made also in the drag plate, the block *H* was made to extend from end to end of the forks; this then blocked off the end of the opening in the fork of the pattern. When this pattern was first mounted on the two plates, these points were a little different, and they gave considerable trouble, for instead of continuing the block *H* from end to end of the fork, each end had its own separate building-up block, and the end or opening in the forks was left open, and when a mold was made off it the sand would push out the opening at the end of the forks and thus break away from the sand above, and when the mold was lifted off the machine this sand within the opening of the fork would stick down on the top of the stool that was made to strip this opening, so short sprigs were set in the opening to bring up this sand core. If the sprigs were not set just so then right up to the end or back of the opening the sand would stay down and of course this left a small snag of iron on every casting that had to be ground off; therefore when the change was made as first described, the sand down in the pocket within the forks could not push out, and consequently could not crack away from the sand above it, and when the mold was lifted off the machine the sand would come up without any sprig set in it, and the opening in the drag plate represented by the stool *L* would also free itself of the sand core that was formed with it; but when each end of the fork had its own building-up block the cavity in the drag plate was so small that sometimes the sand would stay down and thus make it necessary to make a new mold, for the piece was too small to lift out of the pocket, and of such shape that an unskilled molder could not patch up the mold correctly, and after a few molds the sides of this pocket would get very dirty and then stick in every mold, and to get at such a little opening and clean it out was such a trouble as to cause the operator to call it all right when it was only partly right. When the opening was made larger the operator could see what he was doing and do it far quicker than he could before, and the larger quantity of sand helped to hold the core together, and bring out a perfect impression of the plate.

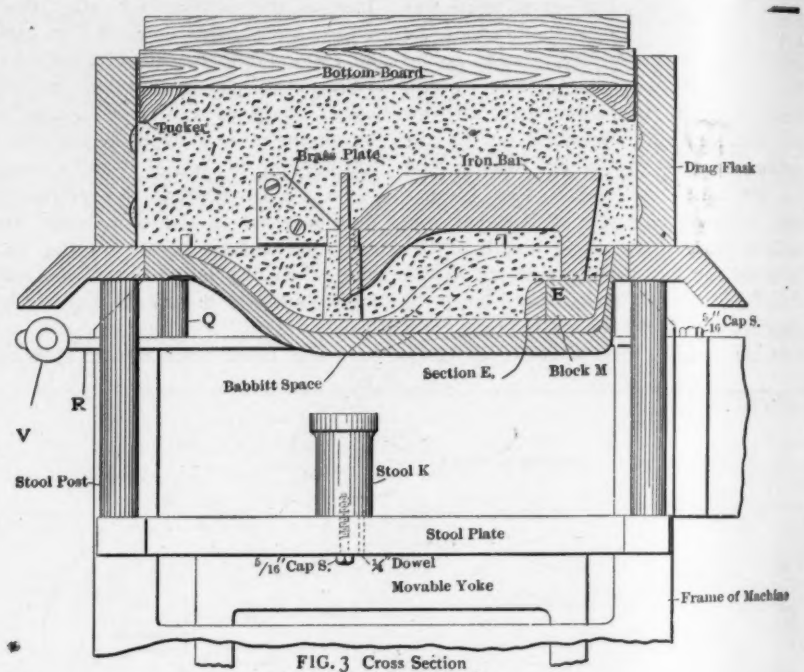


FIG. 3 Cross Section on Line A-B of Fig. 2 Showing Drag Flask Patterns and Plates End View

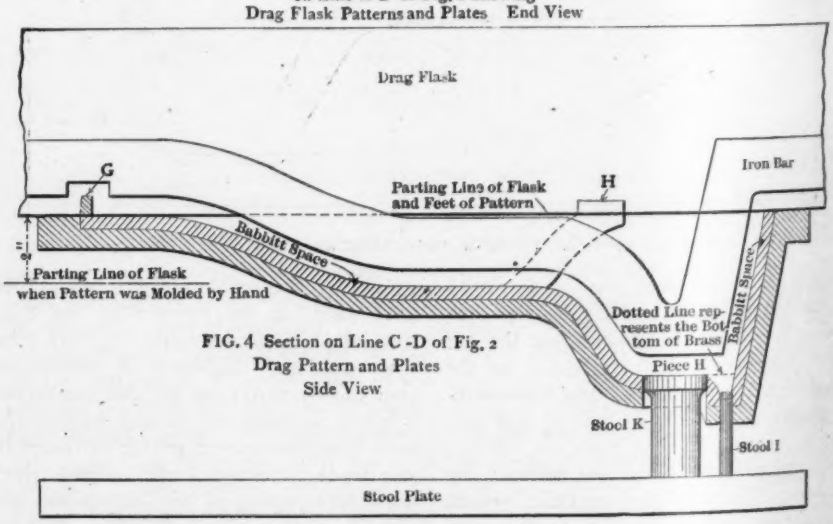


FIG. 4 Section on Line C-D of Fig. 2 Drag Pattern and Plates Side View

Going back to the cope plate, the out-

line of the interior of the opening within the forks was scribed on the top of the building-up block on which it set; then all this within the scribed outline was cut out clear through the block, and directly under this opening and in the pattern pate upon which the building-up block rests another hole was cut out about four times the size of the top opening; this opening was for allowing any sand that may fall through the top opening to pass through the pattern plate and thus to a position that would cause no harm to the working of the machine. A stool *J* of Fig. 6 was made to strip the opening in the fork; this stool passed from the opening in the fork through the opening in the pattern plate to the top of the stool-plate, see Fig. 6. Taking up the foot section of the pattern which also had to be stripped so that the two outlines desired were cast in the plate, it then remained to make and fit within it the desired stool *U* of Fig. 6, so for about one-half inch back from the face of the foot an opening was cut into the plate, and then a stool was made out of the brass and fitted to this opening and supported in that position by the stool post *U*. *T* represents the brass stool stripper that was fitted into the opening of the block *W*. An opening was made in the pattern plate so that the dirt would pass through the pattern plate to the floor below. When this face of the foot was first rigged up by the pattern-mounter, he made the parting line across the face of the foot, and whereas this was very objectionable in the casting, as this face of the casting had to go up against the casting at a certain angle, this casting had a seam across the center of the foot, which made the casting sometimes set at one angle and again at another, all due to the way the machine fitters would tighten up or on the bolts; and again this face of the foot being parted meant that in the drag plate a projection on the iron bar must set down in front of the foot to bring up the sand in that pocket, and as there was not much sand in the pocket it meant that the bar was set very close up to the pattern, and it was very difficult to tuck the sand hard enough against the face of the foot to keep it from swelling when poured. If the operator took time enough he might tuck the sand and thus prevent it from swelling at that point, but the time spent in doing this would hold back the day's output, and must be avoided, if possible; so as to overcome this, the plates were constructed as shown in Fig. 3; the block *M* was the block that made the parting go around the ends of the pattern instead of across it, and instead of having the iron bar go down in front of the foot or face *E* (Fig. 3) of the foot, it was cut off and rested on the top of the block *M*, this cutting out the tucking in of the drag mold on the face of the foot *E*. A representation of this iron bar can be seen in Fig. 3; and it was about 1½ inches deep and about ⅜ inch thick, and ran the whole length of the mold, resting on brass strips on the flask. Fig. 3 shows a cross section of the bar on the lines *A-B* of Fig. 2. This bar comes down fairly close to the face of the plate. Part of the back and side of the foot having been cast in the drag section of the mold made it necessary to have the shape of that section made on the drag plate; this is designated by *E*. On the face of the flat section of the iron drag pattern were fastened the three small sections, *G*, *N* and *O*, and in the correct location, and in the bottom of the deep cavity was the stool *K*, made principally to strip the sand out of the pocket, so it was made large as possible, covering only the flat surface of the bottom of the cavity; this is shown in Figs. 3 and 4, as well as the stool *I* made to strip the small cavity, thus completing the fitting of the plates and patterns on the machine.

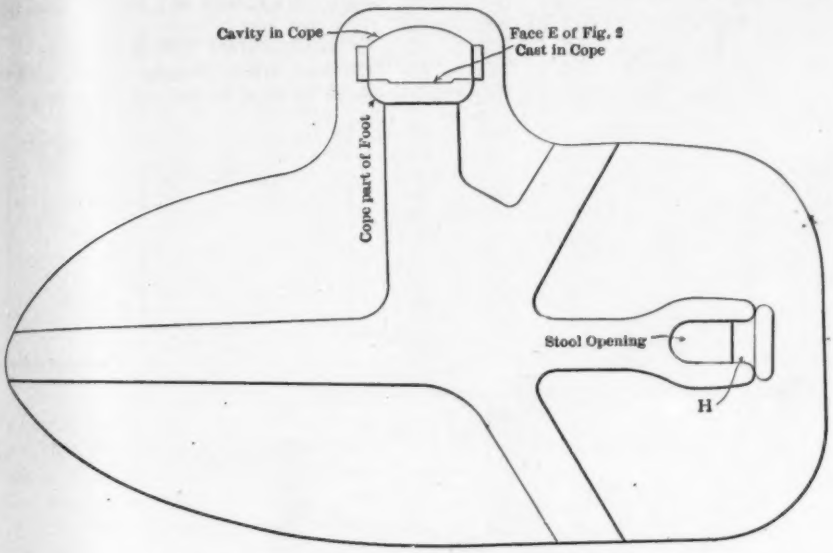


FIG. 5. BUILDING-UP BLOCK FOR COPE PLATE.

A correspondent calls attention to the advantage of the ordinary goggles or eye shields for the use of patternmakers and others who turn wood in the lathe. He states that his experience with them has been very satisfactory, as they enable him to keep his eyes wide open, and know what he is doing without danger of being struck in the eye by chips. This idea is not new, and wood turners have, for a long time used them, but the advantage of them is not as generally known as it deserves to be.

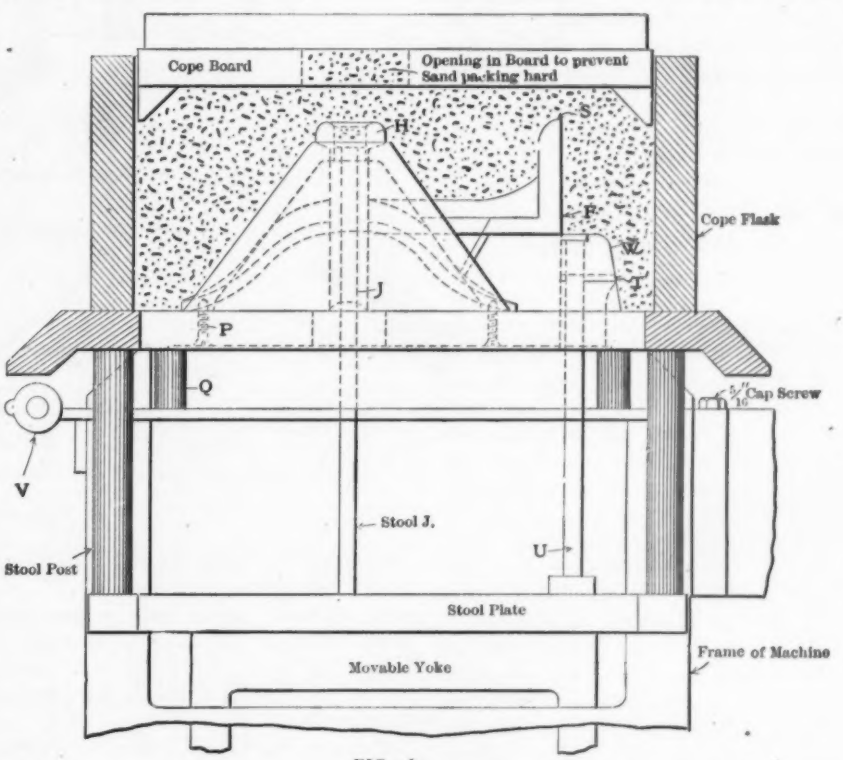


FIG. 6

FIG. 6. TRANSVERSE SECTION OF MACHINE, SHOWING COPE-FLASK PATTERNS AND PLATES.

The Westinghouse-Finzi Alliance.

We are informed that since March 1, 1906, an alliance has been entered into by the Société Anonyme Officine Elletro-Ferroviarie of Milan, Italy, with a capital of £1,500,000, having for its object the making, installation and dealing in mechanical material, rolling stock and electrical equipment, and the Société Anonyme Westinghouse of Paris, with a capital of frs. 25,000,000, having for its object the making of electrical material and brakes. By this alliance the electrical installations of Italy will be studied together by the two companies; single-phase traction installations will bear the name Westinghouse-Finzi, and will be the application of important patents of the Soc. An. Westinghouse, and of those of Dr. George Finzi, who has been the first in Italy to make the application of single-phase motors to traction. Dr. Finzi is actually the deputy manager of the Officine Elletro-Ferroviarie. This alliance, after the experience and discussion of which electric traction has been the object, has an exceptional import and significance: it brings together the positive results of the single-phase system that the two companies have independently obtained.

At this time of the industrial renaissance in Italy, the Westinghouse-Finzi alliance and the construction of vast workshops by the Soc. An. Officine Elletro-Ferroviarie at S. Cristoforo de Milan are enterprises which speak well for the development of the railroads and the electrical industry in Italy.

List of Cone and Gear Ratios for Variable-Speed Drives.

BY W. OWEN.

Much has been written lately upon the calculations involved in the design of cones, gears, etc.—short, slide rule and graphical methods have each had their turn—yet, while quite admitting the utility of these, some from a practical, and others from merely an educational standpoint, a tabulated list of gear powers for different speed ratios is far more likely to appeal to the practical man than any number of short methods, however simple in their application.

With this idea in view, I have compiled the accompanying tables, and, for the benefit of those sufficiently interested, the method employed in working out the quantities is given. No short methods have been used, but all the results have been arrived at by the aid of four-figure logarithms.

$$\text{Speed ratio} = \frac{\text{highest spindle speed}}{\text{lowest spindle speed}} = \frac{S}{s}.$$

$$\text{Ratio of advance} = \sqrt[N-1]{\frac{S}{s}}, \text{ where}$$

N = total number of speeds in the range.

$$\frac{D}{d} = \sqrt{\left(\sqrt[N-1]{\frac{S}{s}}\right)^{c-1}}, \text{ in which}$$

D = diameter of large step of cone,
d = diameter of small step of cone,
c = number of steps on cone.

$$\text{Ratio of counter speeds} = \left(\sqrt[N-1]{\frac{S}{s}}\right)^{c}.$$

$$\text{Ratio of back gear, or low back gear} = \left\{\left(\sqrt[N-1]{\frac{S}{s}}\right)^{c}\right\}^{2}.$$

$$\text{Ratio of high back gear} = \left\{\left(\sqrt[N-1]{\frac{S}{s}}\right)^{c}\right\}^{4}.$$

It will be seen from the foregoing that the method of using the full cone range before changing the counter speeds has been adopted, as by this arrangement about 20 or 25 per cent. more power is gotten into the machine than by changing the counter speeds between the steps of the cone.

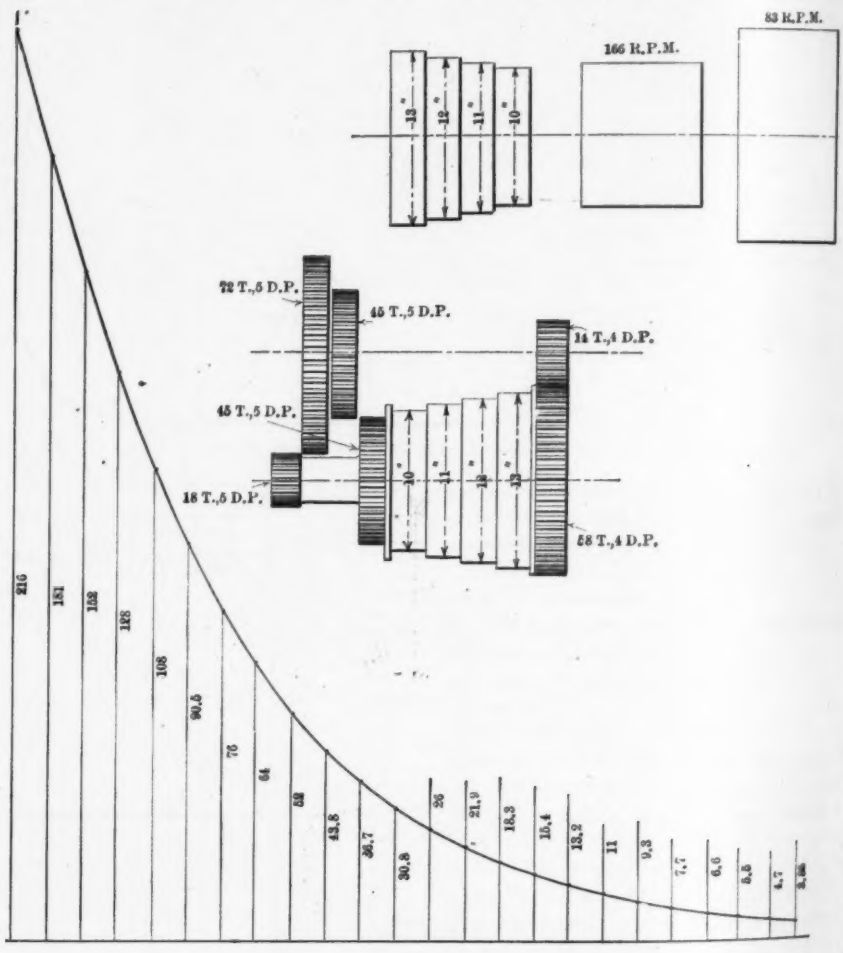
Owing to the fact that there is a difference in the nomenclature of back gears as used in this country and in America, to avoid any possibility of error, I have worked out, by the aid of the tables, a complete cone drive, showing the method of application of the ratios embodied in the tables.

The case taken is that of a lathe having 24 speeds, ranging from 4 to 216 revolutions per minute, the changes being effected by means of a four-speed cone, two counter speeds and two back gears. Dividing the highest by the lowest spindle speed, the speed ratio is obtained, viz.:

$$\frac{216}{4} = 54.$$

Referring to the list embodying the conditions stated above, opposite the next highest speed ratio to the one just calculated, viz., 55, will be found the required ratios, as follows:

Ratio of advance = 1.191., $\frac{D}{d}$ = 1.299.,
Ratio of counter speeds = 2.012.,
Ratio of low back gear = 4.048.,
Ratio of high back gear = 16.39.



SPEED, GEAR AND PULLEY DIAGRAM.

Assuming 13 inches to be decided upon as the diameter of the largest step of the cone, the diameter of the smallest step is obtained by dividing 13 by

$$\frac{D}{d}, \text{ or } 1.299, \quad \frac{13''}{1.299} = 10''.$$

The diameters of all the steps of the cone are 10, 11, 12 and 13 inches.

It is known that the highest spindle speed = 216 revolutions per minute, therefore the high counter-speed

$$= \frac{216 \times 10}{13} = 166 \text{ revolutions per minute.}$$

$$\text{Low counter-speed} = \frac{\text{high counter speed.}}{\text{ratio of counter speeds}}$$

$$= \frac{166}{2.012} = 83 \text{ revolutions per minute.}$$

Fixing upon a suitable center distance

12 SPEEDS — 3 SPEED CONE 2 COUNTER SPEEDS 1 BACK GEAR					16 SPEEDS — 4 SPEED CONE 2 COUNTER SPEEDS 1 BACK GEAR					18 SPEEDS — 3 SPEED CONE 2 COUNTER SPEEDS 2 BACK GEARS					
SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	BACK GEAR RATIO	SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	BACK GEAR RATIO	SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	LOW BACK GEAR RATIO	HIGH BACK GEAR RATIO
20	1.313	1.313	2.263	5.126	20	1.221	1.349	2.222	4.939	20	1.192	1.192	1.693	2.869	8.233
25	1.340	1.340	2.406	5.789	25	1.240	1.380	2.363	5.588	25	1.209	1.209	1.766	3.118	9.78
30	1.359	1.359	2.509	6.298	30	1.254	1.404	2.473	6.115	30	1.222	1.222	1.825	3.332	10.10
35	1.381	1.381	2.634	6.937	35	1.268	1.429	2.587	6.692	35	1.234	1.234	1.874	3.511	12.32
40	1.398	1.398	2.734	7.474	40	1.278	1.445	2.669	7.125	40	1.243	1.243	1.920	3.684	13.58
45	1.414	1.414	2.826	7.987	45	1.289	1.463	2.762	7.628	45	1.251	1.251	1.957	3.830	14.67
50	1.427	1.427	2.905	8.441	50	1.298	1.479	2.842	8.076	50	1.259	1.259	1.995	3.981	15.85
55	1.440	1.440	2.986	8.921	55	1.306	1.491	2.905	8.441	55	1.266	1.266	2.030	4.121	16.98
60	1.451	1.451	3.056	9.337	60	1.314	1.506	2.982	8.898	60	1.273	1.273	2.063	4.254	18.09
65	1.462	1.462	3.126	9.772	65	1.320	1.516	3.031	9.187	65	1.278	1.278	2.088	4.361	19.02
70	1.471	1.471	3.183	10.13	70	1.327	1.529	3.101	9.620	70	1.283	1.283	2.112	4.459	19.88
75	1.480	1.480	3.243	10.52	75	1.334	1.541	3.168	10.03	75	1.289	1.289	2.142	4.590	21.07
80	1.489	1.489	3.304	10.91	80	1.339	1.550	3.215	10.34	80	1.294	1.294	2.168	4.699	22.08
85	1.497	1.497	3.357	11.27	85	1.345	1.560	3.272	10.70	85	1.299	1.299	2.194	4.810	23.14
90	1.505	1.505	3.408	11.61	90	1.350	1.568	3.321	11.03	90	1.303	1.303	2.201	4.844	23.46
					95	1.355	1.577	3.370	11.36	95	1.307	1.307	2.231	4.979	24.79
					100	1.359	1.584	3.140	11.63	100	1.310	1.310	2.249	5.056	25.57
					110	1.368	1.600	3.502	12.27	110	1.318	1.318	2.290	5.241	27.47
					120	1.376	1.614	3.584	12.84	120	1.325	1.325	2.326	5.411	29.27
					130	1.383	1.627	3.661	13.41	130	1.331	1.331	2.358	5.562	30.93
					140	1.390	1.639	3.733	13.93	140	1.338	1.338	2.396	5.741	32.96
					150	1.396	1.649	3.798	14.43	150	1.345	1.345	2.433	5.919	35.02

TABLE I. CONSTANTS FOR CONE PULLEY AND BACK-GEAR DESIGN.

for the back gears, say 9 inches and pitch of gears, = 4 and 5 per inch, the total number of teeth in gears in front of cone $= 4 \times 9 \times 2 = 72$. Pinion for gear in front of cone

$$= \frac{72}{4.048 + 1} = \frac{72}{5.048} = 14 \text{ teeth.}$$

Wheel on spindle $= 72 - 14 = 58$ teeth.

Total number of teeth in each set of gears behind cone = 90, one set being equal wheels of 45 teeth.

As we have already obtained $\frac{58}{14}$ of the required high back-gear ratio 16.39, the wheels must be arranged to give a ratio of

$$\frac{16.39 \times 14}{:8} = 3.96.$$

Therefore pinion on cone pulley

$$= \frac{90}{3.96 + 1} = \frac{90}{4.96} = 18 \text{ teeth.}$$

Wheel on back shaft $= 90 - 18 = 72$ *T*.

RECAPITULATION.

Ratios given on list $\frac{D}{d} = 1.299.$

Actual Ratios $\frac{13}{10} = 1.3.$

Ratio of counter-speeds $= 2.012.$

Actual Ratios $\frac{166}{83} = 2.$

Ratio of low back gear $= 4.048.$

Actual Ratios $\frac{45}{45} \times \frac{14}{58} = 4.14$ to 1.

Ratio of high back gear $= 16.39.$

Actual Ratios $\frac{18}{72} = \frac{14}{58} = 16.57.$

Required speeds 4 to 216.

Actual speeds 3.85 to 216. R.P.M.

20 SPEEDS — 5 SPEED CONE 2 COUNTER SPEEDS 1 BACK GEAR					24 SPEEDS — 4 SPEED CONE 2 COUNTER SPEEDS 2 BACK GEARS						24 SPEEDS — 6 SPEED CONE 2 COUNTER SPEEDS 1 BACK GEAR				
SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	BACK GEAR RATIO	SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	LOW BACK GEAR RATIO	HIGH BACK GEAR RATIO	SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	BACK GEAR RATIO
20	1.170	1.369	2.193	4.808	20	1.139	1.215	1.683	2.231	8.017	20	1.139	1.352	2.065	4.266
25	1.184	1.403	2.328	5.420	25	1.150	1.234	1.752	3.068	9.410	25	1.150	1.418	2.313	5.351
30	1.196	1.431	2.449	5.998	30	1.160	1.249	1.811	3.281	10.76	30	1.160	1.450	2.438	5.943
35	1.206	1.454	2.550	6.501	35	1.168	1.263	1.862	3.461	12.02	35	1.168	1.474	2.541	6.457
40	1.214	1.473	2.636	6.950	40	1.174	1.272	1.900	3.611	13.04	40	1.174	1.494	2.619	6.861
45	1.222	1.494	2.726	7.430	45	1.180	1.281	1.939	3.760	14.14	45	1.180	1.512	2.701	7.291
50	1.228	1.508	2.793	7.798	50	1.185	1.290	1.973	3.894	15.17	50	1.185	1.530	2.772	7.685
55	1.234	1.523	2.861	8.185	55	1.191	1.299	2.012	4.048	16.39	55	1.191	1.547	2.854	8.143
60	1.240	1.538	2.931	8.590	60	1.196	1.306	2.040	4.142	17.32	60	1.195	1.562	2.914	8.487
65	1.246	1.552	3.002	9.016	65	1.199	1.313	2.068	4.278	18.30	65	1.199	1.575	2.975	8.847
70	1.250	1.563	3.052	9.311	70	1.203	1.319	2.093	4.382	19.20	70	1.203	1.587	3.028	9.170
75	1.255	1.575	3.112	9.683	75	1.206	1.324	2.114	4.471	19.99	75	1.206	1.597	3.075	9.454
80	1.259	1.585	3.162	10.00	80	1.210	1.331	2.144	4.596	21.13	80	1.210	1.611	3.139	9.854
85	1.263	1.595	3.214	10.33	85	1.213	1.336	2.164	4.681	21.92	85	1.213	1.620	3.183	10.13
90	1.267	1.605	3.266	10.67	90	1.216	1.341	2.186	4.777	22.82	90	1.216	1.630	3.231	10.44
95	1.271	1.615	3.315	10.99	95	1.219	1.345	2.206	4.866	23.68	95	1.219	1.640	3.276	10.74
100	1.275	1.626	3.369	11.35	100	1.222	1.351	2.230	4.975	24.75	100	1.222	1.651	3.332	11.10
110	1.280	1.639	3.436	11.80	110	1.227	1.359	2.266	5.134	26.35	110	1.227	1.667	3.410	11.63
120	1.286	1.654	3.520	12.39	120	1.231	1.366	2.295	5.267	27.74	120	1.231	1.681	3.477	12.09
130	1.292	1.669	3.601	12.97	130	1.236	1.374	2.333	5.445	29.65	130	1.236	1.698	3.565	12.71
140	1.297	1.684	3.673	13.49	140	1.240	1.380	2.363	5.588	31.23	140	1.240	1.712	3.634	13.20
150	1.302	1.694	3.737	13.96	150	1.244	1.388	2.394	5.733	32.87	150	1.244	1.726	3.705	13.73

TABLE 2. CONSTANTS FOR CONE PULLEY AND BACK-GEAR DESIGN.

Some New England Shop Notes.

During a recent trip through Massachusetts and Connecticut, I had the privilege of looking over a number of machine-building establishments, several of which I had not before visited. One of these plants was that of Baxter D. Whitney & Son, of Winchendon, Mass., which concern, as most readers of the AMERICAN MACHINIST are aware, is one of the oldest of the New England machinery establishments now in existence, the senior member of the firm, Baxter D. Whitney, having built his first wood planer in 1846, in an old building located on the site of the present works, while for several years prior to that date he was engaged in making machinery for manufacturing pails and tubs, and during that period also built a number of looms for the weaving of cashmere.

first manufacturer to introduce a radial drill into the United States, he having purchased this machine of Sir Joseph Whitworth, of Manchester, England, in 1867. Quite similarly when C. H. Norton, of Worcester, brought out his new plain grinder a few years ago, the firm was nearly (though not quite) the first to adopt it, one of a pair of these machines pointed out to me by W. M Whitney being the second machine of this type built by Mr. Norton; the first grinder I believe went to R. Hoe & Co., of New York City.

Of course considerable use is made of jigs and fixtures for facilitating operations, and one of the radial drills I noticed was provided with an auxiliary floor plate of considerable length to permit castings such as side frames of awkward size and shape to be handled easily, yet allowing the drill itself to be of light

smooth-faced rolls, the thickness (or rather thinness) of the shaving removed being regulated by adjusting the knife-holder.

The grinder referred to receives the knife already squared along both edges and ends, and slotted for the clamping screws, and with one emery wheel produces a very slight bevel upon the face of the blade, while the other wheel bevels the back of the knife to an angle of some 40 degrees. The two wheels working simultaneously on the back and face of the knife edge are about 3 inches diameter and independently adjustable to maintain the desired bevel as the wheels wear. The work is reciprocated past the edges of the wheels by a screw-driven table which slides on a rail with a vertical face, and after the blade is nicely ground it is run under a hardened burnisher on the same machine, which

30 SPEEDS — 5 SPEED CONE, 2 COUNTER SPEEDS, 2 BACK GEARS						36 SPEEDS — 6 SPEED CONE, 2 COUNTER SPEEDS, 2 BACK GEARS					
SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITTO -D/D	COUNTER SPEED RATIO	LOW BACK GEAR RATIO	HIGH BACK GEAR RATIO	SPEED RATIO	RATIO OF ADVANCE	LARGE STEP OF CONE SMALL DITO -D/D	COUNTER SPEED RATIO	LOW BACK GEAR RATIO	HIGH BACK GEAR RATIO
20	1.109	1.224	1.675	2.805	7.870	20	1.089	1.238	1.669	2.787	7.769
25	1.118	1.249	1.744	3.041	9.247	25	1.096	1.258	1.736	3.011	9.069
30	1.124	1.260	1.793	3.214	10.33	30	1.103	1.277	1.799	3.236	10.47
35	1.131	1.279	1.851	3.428	11.75	35	1.107	1.288	1.837	3.373	11.38
40	1.136	1.290	1.892	3.581	12.82	40	1.111	1.301	1.880	3.535	12.49
45	1.140	1.305	1.925	3.707	13.74	45	1.116	1.315	1.931	3.726	13.88
50	1.144	1.308	1.959	3.837	14.72	50	1.118	1.320	1.949	3.798	14.43
55	1.148	1.317	1.993	3.972	15.78	55	1.121	1.330	1.985	3.938	15.50
60	1.152	1.327	2.030	4.121	16.98	60	1.124	1.339	2.015	4.059	16.47
65	1.154	1.331	2.046	4.188	17.54	65	1.127	1.348	2.046	4.184	17.51
70	1.158	1.341	2.087	4.335	18.79	70	1.129	1.354	2.065	4.266	18.20
75	1.161	1.348	2.111	4.457	19.86	75	1.131	1.360	2.094	4.385	19.23
80	1.163	1.353	2.128	4.529	20.51	80	1.133	1.365	2.109	4.446	19.77
85	1.165	1.358	2.148	4.613	21.28	85	1.135	1.373	2.138	4.571	20.89
90	1.168	1.365	2.175	4.732	22.39	90	1.137	1.378	2.159	4.660	21.68
95	1.170	1.369	2.193	4.808	23.12	95	1.139	1.385	2.183	4.764	22.70
100	1.171	1.372	2.203	4.853	23.55	100	1.140	1.388	2.195	4.817	23.20
110	1.176	1.384	2.252	5.070	25.70	110	1.144	1.400	2.241	5.021	25.22
120	1.180	1.393	2.289	5.236	27.42	120	1.147	1.408	2.275	5.176	26.79
130	1.182	1.397	2.310	5.333	28.44	130	1.149	1.415	2.300	5.291	28.00
140	1.186	1.407	2.350	5.521	30.48	140	1.151	1.421	2.326	5.411	29.27
150	1.189	1.415	2.380	5.662	32.06	150	1.153	1.428	2.348	5.516	30.42

TABLE 3. CONSTANTS FOR CONE PULLEY AND BACK-GEAR DESIGN.

A WOOD-WORKING MACHINE PLANT.

Although dating back as it does to well over a half century ago, there are about this concern no evidences of the antique either as regards methods or equipment. The product manufactured today includes wood-planing, molding and scraping machines, barrel-stave saws and back knife gage lathes, the latter being used for turning out various kinds of woodwork of fancy outline. The processes followed and tools employed in producing the different parts entering the makeup of this machinery are of the same interesting character as those to be seen in modern tool-building shops; planer rolls, shafts, etc., being finished by grinding, gears cut from the solid blank and turret lathes, millers, planers, etc., of the latest design being much in evidence.

Mr. Whitney is said to have been the

enough proportions to be freely manipulated for the quick jigging of holes and the facing of bosses. Floor plates are used too in the erecting department, and in a new wing now being added to the main shop a series of such plates with a crane directly overhead, is provided, these extending over a length of some fifty feet, while the sections composing the system have a width of perhaps eight feet.

A KNIFE GRINDER.

A machine noticed on the erecting floor was a two-spindle grinder for sharpening the steel blades or knives used in wood-scraping machines. These latter machines finish wood surfaces by means of a cutting edge similar to a cabinet maker's scraper, though on a much larger scale. The knives are of various lengths up to about 3½ feet, and the work is pushed past the cutting edge by

"tunes" the edge, that is, turns over a fine edge which is suitable for removing a very thin shaving and nicely finishing the surface of the work when the latter is fed past it in the scraping machine.

The knives are approximately ⅛ inch thick and are made in quantities, some twenty-five or thirty blanks cut to length being placed all at once in a special fixture on the miller where, with a slabbing cutter the edges are rapidly trued preliminary to grinding.

A HARTFORD SHOP.

One of the many tool-building firms located in Hartford, Conn., is the Henry & Wright Manufacturing Company, who, in their shops on Sheldon street, devote most of their attention to the production of ball-bearing drill presses. Mr. Henry devotes his time largely to overseeing the manufacturing end of the business, and

generally has something interesting to show machine-shop visitors.

A DRILL PRESS AS A HORIZONTAL BORING MACHINE.

The Henry & Wright drills are regularly made with from one to six spindles, the spindle columns for all machines being alike; the base and table of course vary in size to suit the number of columns to be attached to the machine. For boring the column heads for the spindle a 20-inch drill press dropped on its side with its spindle in horizontal position, is used. The supports for the drill press in this unusual position also support a special table upon which a fixture is mounted to receive the work—the spindle column with its face machined for the sliding head which carries the quill. Special heads carrying a boring bar are dropped on the face of the work and the bar is driven and fed through universal connections from the drill-press spindle. Upon the completion of the boring operation another special head carrying a piloted reamer is placed on the column face and a light hand wheel connected to the reamer shank furnishes a means of actuating the reamer and so finishing the hole.

A PLANING OPERATION.

In planing the drill-press tables considerable care is taken to insure squareness of the working surface with the surface at the back which slides on the face of the column proper. To assist in this operation a setting guide or dummy is provided for the planer platen, which dummy consists of a gray-iron angle whose vertical member is precisely the same in section as the column face. This fixture is carefully made so that the face and both edges of the upright part are square with the planer table. After the drill-press table has been machined in the dovetail at the back, it is slid down on the fixture and clamped with its gib; then jack screws tapped into two fixtures located under the ends of the work are adjusted easily to support the outer ends of the table and clamps carried by the same fixtures secure it for the roughing cut.

After roughing, each table is allowed to season for a considerable length of time and when brought back to the planer is dropped over the fixture, clamped by the gib, and just barely supported at its outer corners by the screws, while a finishing tool is fed across to take out whatever wind there may be in the surface.

BENCH ARRANGEMENT.

The turning department, where spindles, quills, etc., are machined preliminary to grinding, is equipped with a row of portable benches placed midway between two lines of lathes which face each other, one of these lines coming directly under the windows with backs to the wall. The men at both rows of lathes thus have access to the benches and drawers are placed at each side for their convenience. The bench legs or standards are castings and the top surface is of matched stuff four or five inches wide placed crosswise of the bench, so that any portion may be easily renewed whenever necessary.

A SHIPPING CRATE.

Mr. Henry feels that, at least so far as his firm is concerned, the problem of crating machines so that they shall not be injured in transit has been solved. The solution is a steel crate which the company has devised, and now makes large use of, intending eventually to use it altogether for domestic shipments of drills.

This open crate or cage is made of 2x2-inch angles, and the end frames are alike for all drills; the connecting members—three or four angles at front and back and top and bottom—which tie these frames together are of lengths varying with the number of spindles and width of the machine. The end frames are riveted to prevent their being taken apart by the man who opens the crate, while the angles connecting the ends are merely bolted in to admit of easy removal. Aside from the four lengths forming each rectangular end there are two additional angles riveted across between the uprights which are drilled to allow wood struts to be bolted in to secure the machine. The angles connecting the two ends are also drilled for a similar purpose. The whole crate is mounted on wood skids and the weight of the largest size is about 300 pounds.

When shipping in this style of crate, an additional charge is made on the bill to cover the value of the crate and when the customer returns the latter (which when "knocked down" takes little space) this amount is refunded.

A WESTERN CONNECTICUT TOOL-BUILDING ESTABLISHMENT.

During this trip I crossed over from Hartford to Torrington one morning, and spent a half day at the works of the Hendey Machine Company, where, under the guidance of W. P. Norton, many shop methods of interest were seen. A number of these quite naturally were in connection with the scraping of bearing surfaces on tools.

SCRAPING AND LATHE TESTS.

When scraping the carriage ways on lathe beds it is the custom at this shop to bolt a dummy head to the headstock ways and leave it there until the scraping operation is finished. The dummy corresponds in all particulars to the lower portion of the actual head, so that when it is bolted on the ways are finished under precisely the same conditions as obtain when the real headstock is secured in position. The guide on the carriage bridge for the cross slide is brought square with the ways beneath by testing, as the scraping proceeds, with a special fixture scraped to fit the lathe ways and having at one edge a transverse ledge which is dead square with the ways. The fixture is brought up to the carriage and a gage block slid along between the true surface on the fixture and the cross-slide bearing thus showing at once whether the edge of the latter is square with the ways. The top of the apron and the surface under the front of the carriage where the two members are joined, are also scraped carefully to avoid any possibility of springing the carriage and affecting the accuracy of the bearing upon the shears, when the apron is fastened in place.

In testing the parallelism of the live spindle with the carriage shears a stiff arbor about eight or ten inches in length with a collar near each end and one at the middle, is held in the taper hole in the spindle and a light cut taken across the three collars, after which the micrometer is applied to show if the diameters agree within the necessary limits. Now, while the collar at the outer end and the one next to the spindle would seem sufficient to prove the accuracy of the lathe for boring holes up to the depth covered by the arbor, the central collar adds a further refinement in that it furnishes a means of noting whether through any slight and easily corrected inaccuracy in the seating of the carriage on the shears the lathe may have a tendency to bore a little large or small toward the middle of the hole.

HEADSTOCK REINFORCEMENT.

The Hendey-Norton lathe is now being built with a tie-bar reinforcement for the head, as recently shown in these columns. A great many of these heads were going through the works at the time of my visit, and Mr. Norton in speaking of the change from their old design of headstock mentioned that once upon a time a certain chucking machine used much in the shop was being examined, and upon the removal of the spindle the wear revealed in the front bearing indicated that under heavy work there was evidently a backward deflection of the front housing. Upon replacing the spindle an indicator was brought into contact with the front end of the headstock, and during a job of chucking a quite noticeable amount of spring was discovered. This suggested that in the case of an engine lathe which is often subjected to the same stresses as the machine tested, a reinforcement across the top of the head ought to be of decided advantage in preventing any tendency toward cramping of the spindle bearings during heavy chucking or turning operations; hence the adoption of the tie-bar head design.

A SCREW-TESTING MACHINE.

Lead screws are tested at this shop in a special machine designed and built on the spot. The machine has a bed some five feet in length, and at one end has a head with a hollow spindle bored to recieve a draw-in collet, the spindle being

fitted at the rear end with a graduated hand wheel for rotating it. A light form of carriage on the bed is adapted to receive a pair of half-nuts corresponding in length to the regular feed nut in the lathe apron, and when the lead screw to be inspected is slipped into the hollow spindle and grasped by the collet, the thread on the screw is engaged by the nut in the carriage. The latter carries a gaging point (an inserted hardened plug) and opposite this on a support for the end of the screw is attached a micrometer head with its spindle.

If the lead screw has say, six threads per inch, it is obvious that when the hand wheel and spindle are turned exactly six turns the carriage should travel just one inch, if the screw is accurate. The test of each inch of length is made with a set of standard end gages ranging from one inch to 12 inches in length, and as each series of rotations corresponding to an inch of linear movement are given the spindle and screw, the corresponding gage is placed between the micrometer spindle and the gaging surface on the carriage, the micrometer then furnishing a ready means of showing just how near perfection that portion of the screw is which is in contact with the nut. The carriage is drawn along step by step (the graduation on the spindle hand wheel being brought dead to zero each time), and the entire series of gages are used one after another; then without releasing the nut from the screw the latter is released by the collet, the carriage and screw are drawn out for a fresh start, the screw is re-gripped by the chuck and the gaging operation is repeated. Thus the whole length of the screw may be readily tested without once opening the nut.

TAPS AND REAMERS.

For threading the hole in lathe face plates a tap is used in the turret lathe having three distinct sizes, so that as the tap is passed through, each section takes a part of the cut, thus dividing up the chip as if three separate taps were used. The tap is made in one piece, has a pilot at the end, and the three thread sizes are separated by turning clearance grooves equal in width to two or three threads. After this tap is run through a sizing plug is put through by hand.

This plug is threaded but not fluted; it is bored crosswise and fitted with an adjustable plug, which is a little shorter than the diameter of the body in which it fits. The whole thing is turned up and threaded together, and the cross plug is then cut back to the center line, thus forming a cutting edge covering two or three teeth or threads. When this plug is set out slightly above the surface of the threaded body in which it is carried, the teeth scrape and finish nicely the threaded hole in the face plate through which the affair is screwed. There is, of course, little wear upon the main plug, which fits nicely in the hole and acts merely as a lead screw to carry the tool through the work, and as the cut taken is extremely light the cutting plug requires adjusting only at very infrequent intervals. The adjustment is provided by a headless screw at the rear end, and a screw tapped in from the front end of the body locks the plug when set as required.

Hand reamers used on various jobs are provided with a somewhat similar scheme for maintaining sizes of holes. An adjustable plug fitted crosswise in the reamer head is fluted when the reamer is milled, and upon the latter wearing below size the plug is set out a trifle, and its cutting edge then projecting slightly above the rest of the tooth takes a smooth cut of its own through the hole. This type of reamer, like the thread sizing plug, has been used with great success at the Hendey shops. It is obviously intended to be handled with a certain amount of care and judgment.

SLOTTING TOOL POSTS.

Some time ago the Hendey oscillating miller was illustrated in these columns, and I noticed one of these machines at work on a lot of tool posts, cutting slots 1½x⅝ inch in size. The stock had been drilled out, leaving about 3/64 inch on a side to finish out and the round ends of the slot to finish square. The work was slipped into a hole in a square jig held in the miller vise, and the oscillating cutter and the power feed did the rest. The spindle carrying the cutter head was making about 900 oscillations per minute, as I watched it, the time required to finish the slot being about five minutes.

S.

Consul Keene, of Geneva, reports that the opening of the Simplon tunnel which was fixed for April 1 has been postponed until May by the action of the Swiss authorities. It is thought that the use of electrical traction through this tunnel will be the beginning of an extensive use of this power on the railroads in Switzerland. It is only natural that this country so rich in "white coal," should utilize its wealth of water and by the power derived from it, dispense with the enormous quantity of coal imported from Germany, France, Belgium and England.

The captain of a transatlantic steamship is authority for the story that, after a trifling mishap had been repaired, a lady passenger inquired of him what the matter had been. He replied that there was a little difficulty with one of the screws, but that it had been repaired, and that everything was then all right. The passenger then expressed her gratification that the difficulty had been overcome, and at the same time complimented the captain upon his skill in righting matters, then added reflectively: "After all, why should we worry, even if there was something the matter with the screw? It's under the water and doesn't show."

A Comprehensive Time Card.

BY E. T. ELBOURNE.

The use of mechanical time recorders for registering the attendance of workmen is so general now that in dealing with a method of using such recorders, it is sufficient in passing, to enumerate the main advantages of mechanical recorders over the brass check or ticket system, and of the card type of recorder over the key and plunger types.

The brass-check system depends for its reliability almost entirely on personal supervision, and therefore on the integrity of the timekeeper.

Further, by the nature of the checks and check boards or receivers, the work of

Name _____ **No.** _____

Week ending, Thursday, _____ 190

—Only Clock Stampings will be recognised—

Morning up to ½ ' o from 4' o	M	6.0	8.30	2.0		Use Column 2 as return from tea	
EVENING	E		5.30		9.0	Use Column 4 as finally leaving	
DAY	Lost Time	1 IN	2 IN	3 IN	4 OUT	Hours Office Worked All'ce	
F		M					
		E					
S		M					
		E					
Su		M					
		E					
M		M					
		E					
Tu		M					
		E					
W		M					
		E					
Th		M					
		E					
					TOTALS...		

Time Wages	Hrs. @	
Premiums	(as list on other side)	
Special Allowances	(,, ,, ,,)	£
Deductions	(,, ,, ,,)	
	NETT TOTAL	£

FIG. 1. A COMPREHENSIVE TIME CARD.

making up the men's time has to be done in the time office which is, in the majority of cases, at a distance from the general offices, and rarely, therefore, comes under the same supervision—an arrangement that increases the dependence on the timekeeper, without any corresponding advantages.

Mechanical time recorders are free from all suspicion of favoritism, and therefore allow a stricter discipline without friction.

It is not, perhaps, impossible for a man to stamp for his mate, but as detection is almost inevitable, the game is not considered worth the candle.

Mechanical recorders can be placed inside each shop, and the records, when made, can be transferred and dealt with

in any office, and, consequently, under any supervision that may be desired.

The key and plunger types of mechanical recorders are at a serious disadvantage as compared with the card type of recorder in that the stampings have to be taken on trust by the men, and with the former type as much clerical work is involved in making up the total time as with brass checks.

Both of these types are inconvenient for dealing with variations from the ordinary routine as to hours worked or temporary increases of men beyond the intended capacity of the machines.

Time cards, incidental to the use of the card type of recorder, while a little more expensive than the paper sheets used with other types, provide the basis for further routine and disciplinary arrangements, and the particular time card now to be described is a fairly complete application of that idea.

To a large extent the uses of the card illustrated in Figs. 1 and 2 are obvious, but the reasons behind the several points require some explanation, and it will be convenient to take them in order, starting with Fig. 1.

"Only Clock Stampings will be recognized." The display of this legend is important, as otherwise there may be difficulty in dealing with men who are careless. A good rule is to allow each man one omission without penalty, giving him personal warning at the time, and then on the second offense, if within twelve months, to stop his pay. This is not only effective, but so long as everybody is treated alike there will be no dissatisfaction.

Arrangement of stampings.—By numbering the columns on the card, and the corresponding positions of the card receiver on the recorder, instructions for stamping are made easy.

The demonstrations as given could, of course, be extended to cover night-shift stampings if required.

It will be observed that there is no provision for stamping out before breakfast (8 a.m.), dinner (1 p.m.) and tea (5 p.m.). This allows the men to get out of the works a minute or so earlier, and allows a better arrangement of the "In" stampings, so that the time, as a whole, is more readily computed in the office.

On finally leaving each day, the cards must be stamped "Out," and this means that if a workman failed to return after a meal, he would not be paid for the time before the meal, as there would be no "Out" stamping. Of course, in the case of sudden illness, such a rule is not enforced.

With a single break day there is not the same necessity for omitting the "Out" stampings before meals, though there is practically no risk of abuse if they are omitted.

Hours worked. These figures must be known in any method of computing time wages, but by noting the hours worked apart from the quarter- or half-time allowance in respect to overtime, the consulting of that allowance is certainly as simple, and the advantage is conferred of being able to check the total hours booked each day to different jobs.

"Overtime Allowance." With the hours worked appearing as a separate total, the overtime allowances must also appear separately. This is an advantage when overtime allowances are treated as a shop charge in the cost accounts. Whether they should be so treated is a question of conditions, although as a matter of principle, overtime allowances constitute a shop charge when they are the outcome of a general pressure of work, and are direct charges to a job when specially incurred because of that job.

No.

PREMIUMS

£

DAY	Notes re Special Allowances, Meal Times Worked, &c.	Foreman's Initials	Amt.
			£

DEDUCTIONS—Hospital Contributions, Overpay, &c.

Hospital Contribution (by consent)			
Authorised £			

OVERTIME OR SPECIAL PASS OUT, APPROVED.

DAY	Time out	Foreman	Sunday	DAY	Time out	Foreman
F				Tu		
S				W		
M				Th		

This Time Card will be retained in the Office after Thursday (a fresh one being then issued) and re-issued in the racks as a Pay Card on Saturday, when it must be handed to the Pay Clerk as a receipt. Men not working Saturdays, must first refer to the Time Office.

FIG. 2. A COMPREHENSIVE TIME CARD.

It may be noted in passing that operation costs can only be properly compared when these allowances are eliminated.

Lost Time. This information is very readily obtained by a separate operation, the more so as the arrangement of stampings show lost quarters up very plainly.

In a shop working no overtime, it is convenient to derive the hours worked by deducting the lost time from the normal total hours. This obviates the necessity for a further operation to get lost time for disciplinary purposes.

Turning to the reverse side of the card (Fig. 2).

Black segment. This is a device to takes the place of the legend "This Side Out," and apart from saving room on the card strikes the eye better, and in a rack of cards indicates plainly by its absence should a card be placed in the rack the wrong way, minimizing thereby to a negligible quantity any risk of stamping on wrong side.

Premiums. Space is provided for noting by name or number the jobs paid on, and amount of premiums. Such a list is appreciated by the men, and saves inquiries. It is especially useful when the practice obtains of paying such premiums a week late so as to allow more time for inspection, and for computing the premiums in the office. These particulars are not added until the card has been stamped for the week.

Special Allowances, Meal Times Worked, etc. Authorization by the foreman on the time card itself saves the office any necessity of referring back after the event, and by making it an essential preliminary to the allowance or time being passed, each man looks out that his card gets signed when necessary.

Deductions. Mistakes of overpay can happen, and fines or deduction of premiums may be necessary, and it is convenient for office and men to have full details on the card.

In the case of a fine the English Truck Act calls for a written notice to the man concerned, and being by its nature a most distasteful proceeding for the men, it is best to have all fines authorized by the management so as to avoid any arbitrary action on the part of the office staff. Money recovered from workmen in the form of fines should not be appropriated by the employer, but should be credited to a provident or other fund by which the men, as a whole, receive back the fine paid in by one of their number.

Approval of overtime and special pass out. By arranging for overtime to be approved by the foreman in all cases, abuse can be prevented, and, in a large works particularly, this is very necessary.

As regards passing out of men at unusual hours, some routine is necessary under any system. Using this card practically eliminates all clerical work, and ensures proper attention in the office. This approval is necessary before a man is allowed to stamp "Out," other than at the end of the day.

Use as a Pay Card. In issuing the time cards as pay cards on Saturday mornings, with details of pay as indicated in Fig. 1, the cards for absentees are not put into the racks, and it becomes virtually impossible for a man to draw pay for an absent man unless he brings written authority, which can usually be tested by comparison with the absentee's signature on his engagement form.

As the pay cards are handed in in exchange for the pay tin or envelope, they are cancelled.

London.

Engineering Reminiscenses.

BY CHARLES T. PORTER.

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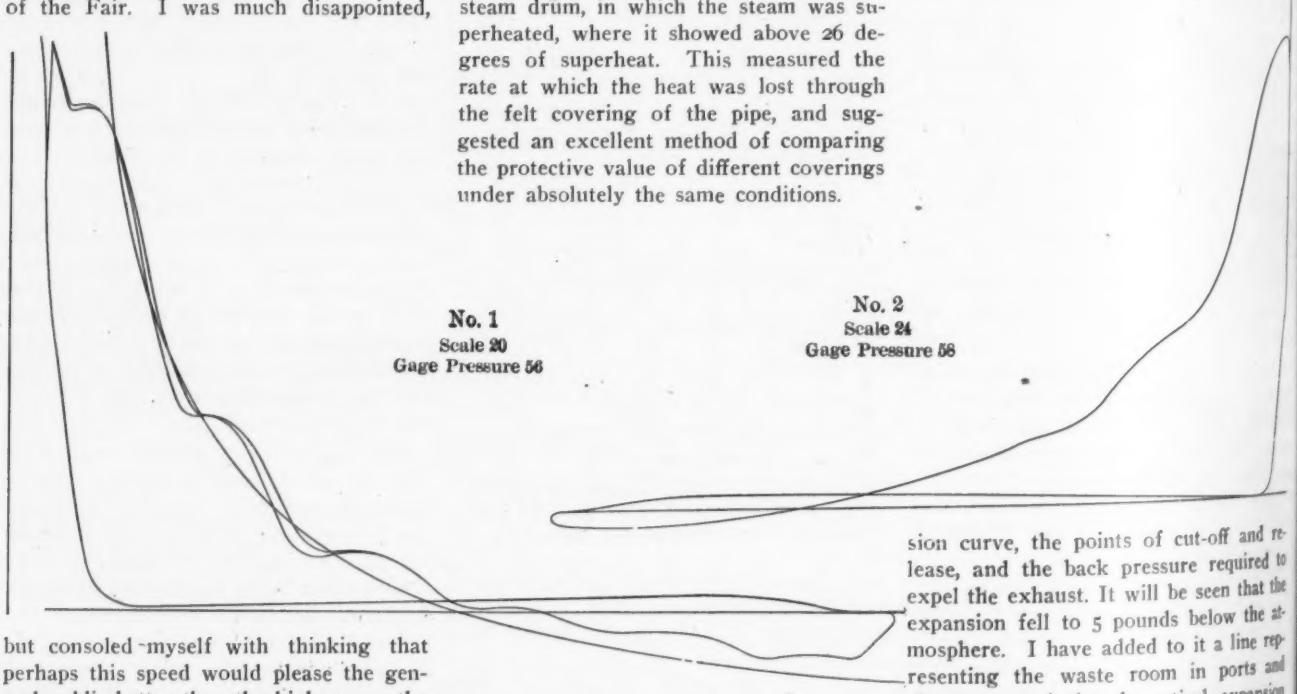
The remark respecting my exhibit of engines and boiler at the Fair of the American Institute in 1870, that there was not a drawback of any kind about it, must be qualified in one respect. I was not able to run my 16x30 engine at the speed of 150 revolutions per minute, as I had intended.

A blunder had been made in the size of the driven pulley on the line of shafting. It was smaller than specified, because the contractor for the shafting put on a pulley he had, and this was not observed till we were running, when it was too late to change it. The exhibitors of machinery in motion all complained that their machines were running too fast, and after two or three days the directors ordered me to reduce the speed of my engine to 125 revolutions per minute, at which speed it was run through the rest of the Fair. I was much disappointed, but consoled myself with thinking that perhaps this speed would please the general public better than the higher one, the engine even then being three or four times too large for its work.

The boiler gave me steam superheated 23 degrees all the time. This I proved by transposing the thermometers. I had two thermometers, duplicates, one on the steam chest, and the other on the first boiler drum, in which the steam was not superheated. The former indicated 23 degrees higher temperature. When these were exchanged the same difference continued to be shown. I was greatly interested in observing in my own and other engines the relative amounts of initial cylinder condensation, as this was shown in the steam blown from the indicator stop-cocks. I had one of these on my steam chest, and the steam blown from this was not visible until three or four inches above it. That blown from the stop-cocks on my cylinder had a very little tinge of white, showing the superheating to have been lost and a slight initial condensation to take place. As the piston advanced, the blowing steam became invisible, showing re-evaporation, through the falling of the boiling point on the expansion.

On other engines, of which several were exhibited, the observation showed large amounts of initial condensation. From one of them I remember the blowing steam looked like a white painted stick.

I observed that the steam only lost three degrees of its superheat in passing through 25 feet of 6-inch pipe from the boiler to the engine. For this comparison I placed a thermometer on the second steam drum, in which the steam was superheated, where it showed above 26 degrees of superheat. This measured the rate at which the heat was lost through the felt covering of the pipe, and suggested an excellent method of comparing the protective value of different coverings under absolutely the same conditions.



The superheating of the steam for our own engine was not affected by the connection of our steam pipe with those of the other engines. The explanation of this phenomenon seemed to be that as our boiler generated far more steam than our own engines required, the current was always *from* our pipe into the connected pipes.

I was here first made alive to the enormous waste of steam in the feed pumps, a separate one for every boiler, including our own. In these the steam has to follow full stroke, at a pressure sufficient, on the larger area of the steam piston, to overcome the pressure in the boiler. Moreover, the extreme heat interval between the temperatures of the entering and the exhaust steam, and the slow motion, permitting the walls of cylinder heads and piston to be cooled very deeply by the exhaust, produces the condensation of probably from five to ten times as much steam as is usefully employed, differing according to the rate of piston motion. I began to rather admire the practice of the English, who knew nothing about boiler feed pumps, except those on the engine, and I certainly wonder that the genius did not arise long before he did, who first thought of exhausting the feed pump into the feed water under atmospheric pressure only, so returning to the boiler all the heat received in the pump that is not converted into the work of overcoming the boiler pressure and the atmospheric resistance, or lost in external radiation.

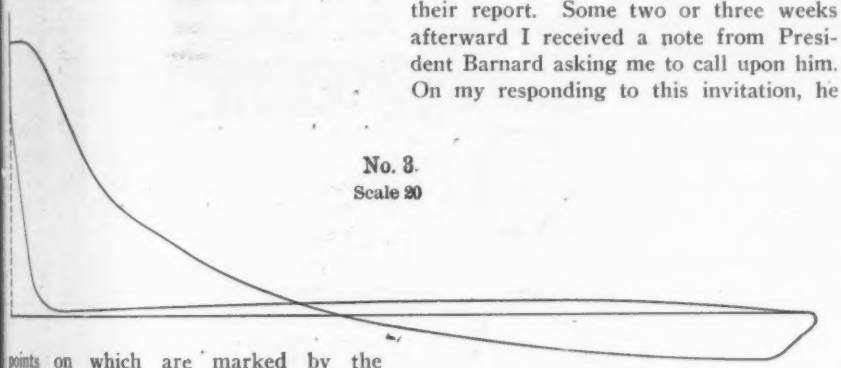
The accompanying diagrams, Nos. 1 and 2, taken, the former on the scale of 20, and the latter of 24 pounds to the inch, represent the performance of this engine in its regular work. The former especially shows distinctly the compression curve, the points of cut-off and release, and the back pressure required to expel the exhaust. It will be seen that the expansion fell to 5 pounds below the atmosphere. I have added to it a line representing the waste room in ports and clearance, and the theoretical expansion curve plotted according to the law of Marriotte, showing the expansion terminating 2.5 pounds above this curve, from the re-evaporation already noted.

After the close of the Fair, this engine was run on several days, under a variety of loads applied by a Prony brake, in the presence of a number of engineers and others who had been invited to witness the trials. Of the diagrams taken on these trials, I find that I have preserved only the two here shown, namely, a single friction diagram from the back end of the cylinder, on a scale of 20 pounds to the inch (No. 3), and a diagram showing large power, taken from the front or crank end, on a scale of 24 pounds to the inch (No. 4).

The former shows the trifling loss from friction in this engine. I have measured this card, and find the mean effective pressure to be 1.1 pounds on the square inch, which, assuming the opposite card to be equal with it, was the friction of the engine.

The exhaust line on No. 3 shows the power required to reverse the direction of motion of the exhaust, which at the end of the stroke was rushing back into the cylinder. This will clearly appear if diagrams 1, 2 and 3 are compared with No. 4. In the latter, although three or four times the weight of steam was exhausted, the back pressure was only 1 pound above the atmosphere.

The latter diagram is especially interesting as showing the identity of the expansion curve with the theoretical, three



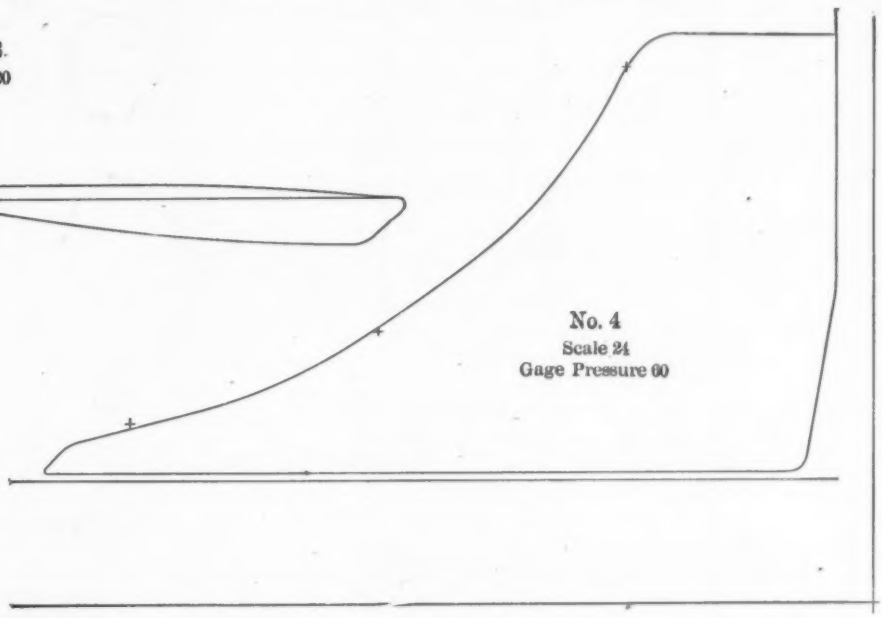
points on which are marked by the crosses. This seemed to show that in this large body of superheated steam, the superheat was not all taken up in restoring to the interior surfaces the heat abstracted by the exhaust, but that sufficient remained to supply the heat converted into work on the expansion. The sharp reaction of the indicator while the crank was passing the dead center will also be observed.

After this trial I made a careful comparison of the diagrams taken under the different loads with the friction diagrams, and found the uniform results to be, that the friction diagrams subtracted from the diagrams taken under the load left in each case, of six different loads, exactly the same effective work done that was shown by the brake.

From this I concluded that in these engines the use of the friction brake is unnecessary; the friction is sensibly the same under all loads, and the friction diagram only needs to be subtracted to learn from the diagram the amount of effective work done.

The verdict of the judges, President Barnard of Columbia College, Thomas J. Sloane, the proposer of the gimlet-pointed wood screw now in universal use, in place of the flat-ended screws formerly used, and inventor of the special machinery required for their manufacture, and Robert Weir, engineer in the Croton Aqueduct Department, may be summed up in the single expression from their report, "The performance of this engine is without precedent." For its success I was largely indebted, first, to the remarkable circulation and steam generating power of the boiler, and second, to the superheating of the steam in the second drum.

The subject of the equalizing action of the reciprocating part of the engine was not considered in the report of the judges. Indeed, the speed of that engine, 125 revolutions per minute, was not sufficient to develop this action to any important extent. But there was another reason behind that. As already related in a number of these reminiscences published two years ago, I invited the judges, directly after the close of the Fair but before making their report, to witness a demonstration of this action in my little shop engine, which invitation was accepted by them, and a highly successful exhibition was made, but this was not alluded to in their report. Some two or three weeks afterward I received a note from President Barnard asking me to call upon him. On my responding to this invitation, he



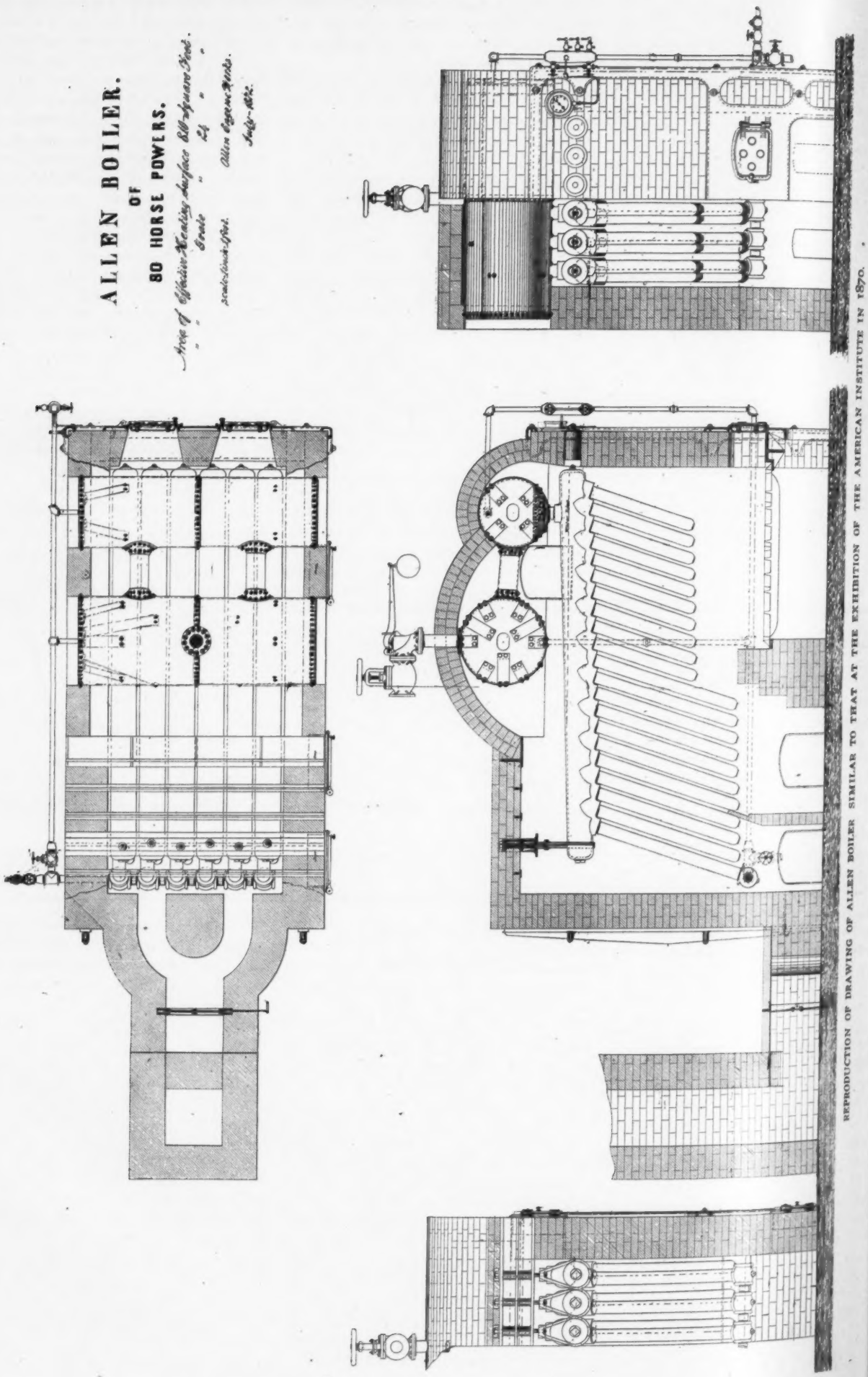
said to me that he had listened to my exposition of this action before the Polytechnic Club of the Institute, but he did not understand it; he had witnessed the experiments with my shop engine, but while he could not question the action in silencing all knock on the centers, still he did not understand it, and not until he investigated the problem in his own way by the method of the calculus, did it become plain to him, and he could not see how I had ever been able to arrive at the exposition of the action without employing that method. In the next article I will describe the simple expository demonstration which I found sufficient, but which seemed not to be satisfactory to his strictly mathematical mind. President Barnard afterward kindly gave me a copy of his demonstration, to insert in my book on the Richards Indicator.

This engine was sold from the exhibition to the Arlington Mills, at Lawrence, Mass. For a reason that I will mention later, I have always regarded this sale as the most important one that I ever made.

The next year we were not exhibitors at the Institute Fair, but our boiler remained in its place and was run by the Institute. This boiler and its setting are shown correctly in the accompanying reproduction of a drawing made at about that time, except that it consisted of nine sections instead of six. At the close of the Exhibition a boiler test was made by the Institute, through a committee of which Professor Thurston was the chairman. Five boilers, including the Allen boiler, were tested, one on each day, in a continuous run of twelve hours. The four besides our own were all different from the boilers exhibited the year before.

A week was spent in preparation for this test. A large wooden tank was constructed, in which was built a surface condenser, consisting of a pile of sections of the Root boiler, laid horizontally, having a total of 1400 square feet of cooling surface. The steam was exhausted into the pipes which were surrounded by the cooling water, thus reversing the construction of surface condensers.

Each boiler was tested by setting its damper and its steam valve wide open, so burning all the coal that could be burned by it under its draft, and delivering freely all the steam that it made. This latter entered the condenser at the top, and the water formed by condensation was drawn off at the bottom, while the condensing water entered the tank at the bottom and was drawn off at the top, the currents of steam and water being thus opposite to each other, which was an ideal construction. The condensing water at a temperature of 45.5 degrees flowed through under the pressure in the city main and was measured in a Worthington meter, and the temperature of the overflow taken. The condensed steam was drawn off into a barrel and weighed, 300



REPRODUCTION OF DRAWING OF ALLEN BOILER SIMILAR TO THAT AT THE EXHIBITION OF THE AMERICAN INSTITUTE IN 1870.

REPRODUCTION OF DRAWING OF ALLEN BOILER SIMILAR TO THAT AT THE EXHIBITION OF THE AMERICAN INSTITUTE IN 1870.

pounds at a time, and its temperature taken. This method was an excellent one.

Not having high chimneys, no boiler had a strong draft, as shown by the coal burned per square foot of grate. Our draft was the strongest of all. The Allen boiler and the Root boiler only gave superheated steam and the competition between them was very close. The valve being wide open, giving a free current into the condenser, the superheat of our steam fell to 13.23 degrees Fahrenheit. Root's superheat was 16.08.

In starting, Root's boiler blew steam from the open try-cock, from water at 46 degrees Fahrenheit, in sixteen minutes from lighting the fire. Next morning our boiler blew steam from water at the same temperature, in twelve minutes, and Mr. Root holding his watch could not resist the ejaculation, "Wonderful boiler!" The Allen boiler, burning 13.88 pounds of coal per square foot of grate per hour, evaporated one cubic foot of water per hour from each 17.41 square feet of heating surface. Root's boiler, burning 11.73 pounds of coal per square foot of grate per hour, required 23.59 square feet of heating surface to evaporate one cubic foot of water per hour.

Our stronger draft, 13.88 against 11.73, accounted for 3.2 pounds of the above superior evaporative efficiency, leaving 3 pounds to be accounted for by the more rapid circulation in the Allen boiler. The great value of the inclination of the tubes was thus established. The report contains this sentence: "The Committee desire to express their appreciation of the excellent general arrangement and proportions which gave to the Allen boiler its remarkably high steaming capacity.

The reader will observe the pains taken to maintain as far as possible parallel currents of the heated gases through the boiler, and taking the flues off at the bottom, thus bringing all the heating surfaces at the same distance from the furnace into approximately equal efficiency.

The boilers having all had a preliminary trial during the first week, I observed the vapor arising from the exposed surface of the water in the tank, and that this unmeasured loss of heat differed considerably in the different boilers, and was enormously greatest on the trial of the Allen boiler. I said nothing, but went down early on Monday morning and on my way bought a common tin cup about 3 inches deep and 4 inches in diameter, and secured it in one corner of the tank, immersed to a quarter of an inch below its rim, and filled even full of water. This was completed before the arrival of the Committee, and was at once approved by them. I made it my business every day to note the fall of the water level by evaporation from this cup. On the trial of the Allen boiler only the water in the cup was all evaporated, and I had to fill it again. The temperature of the water in the cup was always 8 degrees below that of the surrounding water. It was thus obvious that the evaporation from the tank was greater than the fall of the level in the cup would indicate. The Committee considered that this should be increased as the tension of the vapors. The result was, that the report contained the following item: Units of heat carried away by evaporation at the surface of the tank:

Root boiler,	721,390.8 units;
Allen boiler,	1,178,404.5 units;
Phleger boiler,	378,371 units;
Lowe boiler,	692,055 units;
Blanchard boiler,	268,707 units;

The same Bulkley pyrometer was used in all the furnaces to indicate the temperature of the escaping gases. On Tuesday morning, when my boiler was to be tried, I saw that before my arrival the pyrometer had been set in the brick chimney, where the readings could be conveniently taken by a person standing on the brick surface of the boiler chamber. Its readings averaged 260 degrees Fahrenheit. I did not believe it to be true. At about half past two o'clock, when seven readings had been taken, one each half hour, having got ready some bricks and mortar and tools, I pulled the pyrometer out, and filled up the hole. I then knocked a hole in the side of the brick work, in front of the flue, and set the pyrometer there. The reading rose to 405 degrees, which was the temperature at which the gases then entered the flue, and averaged about 385 degrees during the remainder of the sixteen readings. Root's average was 416 degrees, and Phleger's (also tubular) averaged 503. Obviously the readings taken before the pyrometer was moved should have been rejected; but the boys who did this kind of work added them all together, and our average temperature is printed 345.87 degrees, giving the boiler more credit than it was entitled to by about 40 degrees. I lost a little by this operation. While I was bricking up the hole the fireman came around and told me I was spoiling his fire. When I got the figures of water evaporated and coal burned, I found that in that half hour I had only 900 pounds (three barrels) credited to the boiler, instead of 1800 pounds (six barrels) during every other half hour, being a loss of about .023 in water evaporated, while curiously enough, the coal burned was rather increased.

The point of interest in this incident was the fact, that the gases had lost 125 degrees of heat in traversing a distance in flues and chimney of less than 25 feet. This seems difficult to believe, but they did. There was no leakage as the excellent draft clearly proved, nor any other way of accounting for the discrepancy. The heat had been lost by radiation through the brickwork. I have been waiting ever since for a chance to turn this knowledge to useful account, but it has not come yet. I will content myself with suggesting to somebody else the idea of facing the boiler setting, flues and chimney, not only outside but inside also after leaving the furnace, with white encaustic tiles, which will neither absorb nor radiate heat appreciably. This will pay in maintaining the temperature in a large degree to the top of the chimney, so increasing, perhaps doubling, the strength of the draft. An enormous amount of heat must be lost through the extended surface of the brick boiler setting. It is always observed that the hotter a boiler room is kept, the greater the efficiency of the boiler becomes. This is a slight indication of the great gain which might be effected by the plan I propose.

Before this boiler trial we had lost Mr. Allen, a fact which accounts for Mr. Smith's majority in the Board of Directors, as related last month. Mr. Allen had conceived the idea of the pneumatic riveter, and the high-speed air compressor to furnish this riveter with power. In the latter he utilized the inertia of the reciprocating parts, including two pistons, the steam and the air pistons. This he did with my cordial consent, and indeed there was nothing patentable about that feature anyway. Mr. Allen thus became the originator of this important system, in its two methods, of riveting by percussion and by pressure. Mr. Allen sold out his stock in the engine company to Mr. Hope and Mr. Smith, and built a shop in Mott Haven for the manufacture of the riveters and compressors. He took the boiler in the Fair in part payment, and sold it directly to a party who had erected a woodworking shop at some point on the Harlem river.

The Croton water, which had been fed to the boiler, contained no lime, but some sediment. Mr. Allen had the boiler taken down and taken to our shop for inspection and cleaning. I determined to improve the opportunity to observe the effect of the circulation on the deposit of sediment, and the result of the examination proved most interesting. Each inclined tube had been provided at the end with a brass plug, by removing which it could be cleaned by the running out of the water which it contained. This had not yet been done.

I took out the tubes on one side of one section, ten in all, five over the furnace, and five behind the bridge wall, and planed them in two longitudinally, and had the following revelation: The tubes over the furnace were entirely empty. In those back of the bridge wall a deposit of sediment appeared, only about an inch deep in the first one, and increasing regularly to a depth of 18 inches in the last one, which was not the tube receiving the feed water. So the water, fed into the last tube of each section, deposited its sediment most largely in the first tube it reached. in which the circulation was least active, and had deposited it all before reaching the tubes over the furnace. The remaining long tubes were then cleaned, the tubes cut in two were replaced by

new ones, and the boiler delivered to Mr. Allen. The next stage in its history was very funny. The purchaser, to save the cost of Croton water, fed his boiler from the Harlem river, and within a month it was found to be filled solid with salt. What was done about I never heard.

I thought I could sell the boilers where, as in New York City, they could be fed with water free from lime, and I made a few such sales, but the inspiration which led me to employ the second drum for superheating the steam had deserted me.

I came to the conclusion that by making the first drum a large one, and not extending the nipples into the drum to trap a puddle of water, as I had done, I could superheat the steam in one drum. That was a blunder. I had underestimated the furious circulation, which carried a large amount of spray into the drum. I was misled by the quiet position of the water level, as always shown in the glass gage. Instead of superheated steam, I found the boiler to give very wet steam. That fault of course I could have remedied by returning to my first design. But I was discouraged by other things. The first of course was the impossibility of removing scale by any mechanical means. The most serious discouragement was a cracked header. The inclined tubes, on any plan for their use that I could then design, made cast-iron headers necessary. I had taken great pains to obtain perfect castings, making them of the best iron in baked molds in iron flasks, of uniform thickness, ⅝ in., and ¾ in. where threaded, with cores held perfectly central and remarkably well vented, and felt that I could rely on their soundness; but this defect showed that I could not. So reluctantly I abandoned the manufacture of the boiler.

I believe, however, that there is yet a future for the inclined boiler tube, with independent circulation in each tube, and that better results will be obtained from it than any other form of boiler has as yet given. I have been told by Chief Engineer Melville that all water admitted to the boilers in the United States Navy is made pure enough for pharmaceutical purposes. If this can be done in the navy, it can be done anywhere. Cooling towers make it practicable to return all water to the boiler, even from non-condensing engines. Then only the waste needs to be made good, and any water can be purified for this purpose. Oil or grease with the feed water is readily avoided. Only electrolysis remains to be provided against, which can readily be done, by avoiding the use of any alloy of copper in contact with the water. We may then have boilers of the most durable character, and safe to carry any desired pressure. In present practice the joints in the drums would be welded.

I am ready to communicate to any responsible parties my plans, the result of several years study, for such boilers, made entirely from forged steel, to the introduction of which, were I a younger man, I should devote myself personally, but this my age, now past 80 years, forbids me to attempt.

Systematic Economy in Making Drawings.

BY GEORGE F. SUMMERS.

The strictly mechanical part of drafting is no longer an artistic operation, but a mercantile pursuit carried on not by skilled men but by cheap labor. Thirty years ago a drawing was executed on white paper, was a picture of the object, generally tinted in water-color, and always expensive and incomplete.

The drafting of today is a system of orders for the shop; a skeleton of ideographs to show where the dimensions go. Whereas the old drawing was preserved carefully and was not to be carried to the lathe or planer, the blue-print of today need have no care at all, can go anywhere, no matter how dirty the place; for there is always another to be had from the master tracing for the asking. The system has had a wonderful development within the last 20 years, so that text-books written as long ago as that are now obsolete. The two principles underlying the present methods of making drawings are as follows: To give the shop complete information in the form wanted, and to do so at the very smallest possible cost. To do this a great many shorthand symbols are used to designate some more or less complex shape. For instance, the thread of a common bolt was conventionalized by making the helices straight lines, as in Fig. 1, to save cost in drawing. Note the two end views, the lines showing the chamfer on the head, the saw-tooth lines for the thread outline and the shade lines. It was further simplified, as shown in Fig. 2 by leaving off of the pinked profile for the same reason. A good draftsman of today will reduce the cost of his drawing still further by leaving off the oblique lines and writing a note telling about the thread, as in Fig. 3. Note the omission of everything not strictly necessary. The head is a conventional form to signify that it has six sides and should be shown the same in every projection, and not as it would look. The figures and lines are bold and strong, to prevent burning out in printing. The figures, being the most important part of the drawing, should be the most prominent. The test dimensions are given in this case to make the bolt interchangeable. As all dimensions are in inches in the United States, the inch marks should generally be left off.

It seems reasonable to make no view where a note will answer, because the note is much cheaper; thus, in a cylindrical object the letter *D* after a dimension indicating diameter—that is, that the piece is round—will save an end view. In the case of hexagon-headed bolts and nuts a note, giving the size across flats, will tell just as much as the end view drawn out and dimensioned, costs less and should be used. The use of shade lines is not good. They add to the cost of a drawing, and the light contrasting lines do not print well and are apt to get confused with dimension lines. All lines should be strong and uniform, to make the outline of the part stand out from the fine lines. Cross-sectioning is sometimes necessary, but is expensive. Many firms blacken in their sections in lead pencil, or for earthwork with a stencil brush and blacking. Border lines should be left out, letters and figures should be very plain and neat, otherwise the cheapest made are the best. Care should be taken that figures should be drawn so they cannot be easily mistaken for others; thus a three should not be flat-topped, as it in that form resembles a five, and the five should have its lower loop well open, otherwise a speck of dirt might make it look like a six.

Some firms write fractions in decimals, but it is a mistake. The decimal point is so small an item, and is so important, that an accident to it could easily do much damage; vulgar fractions are much safer and are better for the shop.

Many draftsmen lay down their drawing first and dimension it afterward. A better plan is to dimension each line as it goes down and make sure that the dimension is right before going to the next line. This insures completeness and saves mistakes.

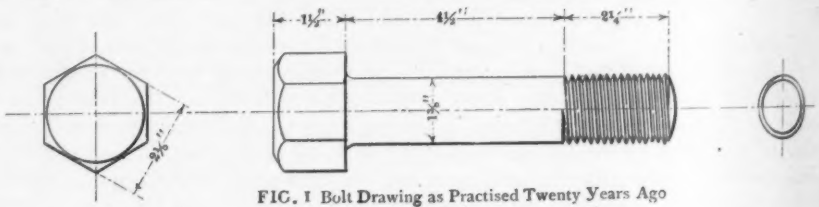


FIG. 1 Bolt Drawing as Practised Twenty Years Ago

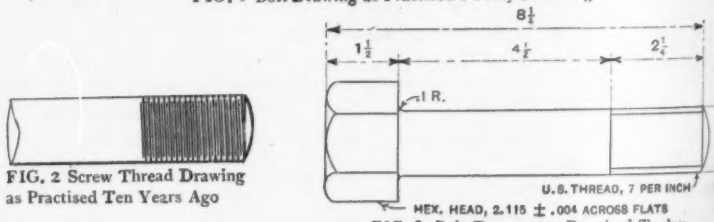


FIG. 3 Bolt Drawing as Practised To-day

FIG. 2 Screw Thread Drawing as Practised Ten Years Ago

Drawings should not be checked. It weakens the draftsman and costs money, and, as a matter of fact, many firms send their drawings unchecked into the shop, and have apparently not so much trouble from spoiled work as concerns that use elaborate systems of checking.

An objection raised to the use of screw propellers on canal boats is that they get fouled with the vegetation of the canal and river. Consul Brittain, of Kehl, has sent in a report describing an experimental trip of a boat designed to navigate canals without this difficulty. This boat is 38.5 meters (126.31 feet) long and has a carrying capacity of 280 tons. Its motive power is a boiler and engine of 25 horsepower, placed at the rear end of the boat. The power is applied by means of two specially constructed paddle wheels which automatically rise and fall as the boat is light or laden, so as to always maintain the same depth in the water. The boat made the trip from Strassburg down the Rhine river to Antwerp, taking seven days to make the trip. The return trip to Strassburg was made in 27 days, through the Meuse river and canals of Belgium and France, and the Rhine-Marne canal of Lorraine and Alsace, to Strassburg, covering a distance of 749 kilometers (465.45 miles). Much of the delay on this trip was caused by passing through some 230 locks in Belgium and France. It is the intention to construct boats with 45-horse-power engines and thus attain a greater speed. This boat is considered a great advance over the horse-drawn boat, as it cuts the time for a trip in two. It is claimed that it is the first canal boat on the German canals which is propelled with other than the usual horse-power.

Letters to the Editor.

A Special Fixture for the Chucking Lathe.

A good example of a job for the chucking lathe is shown in Fig. I. It is a gray-iron casting, and as will be seen from the dimensions given the allowable error in certain particulars is very small.

The most important feature of all, however, is that holes *a* and *b* should be in line with each other, and that they should be at right angles to the holes *c* and *d*, which also should be in the alinement with each other.

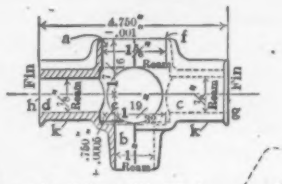


FIG. 1 The Work

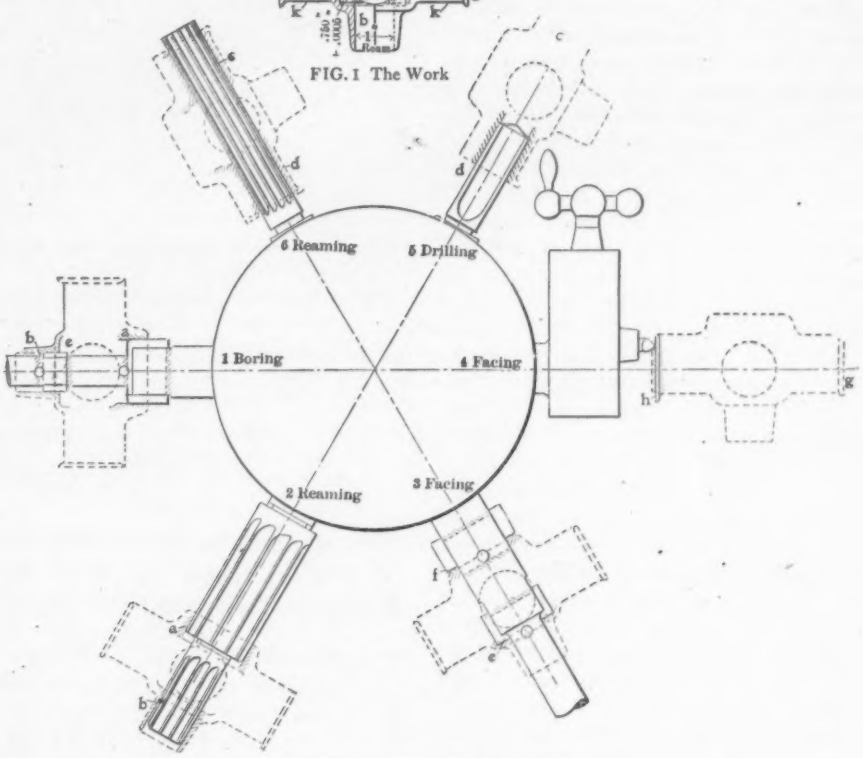


FIG. 2. THE TURRET TOOLS.

FIG. 3 Gage

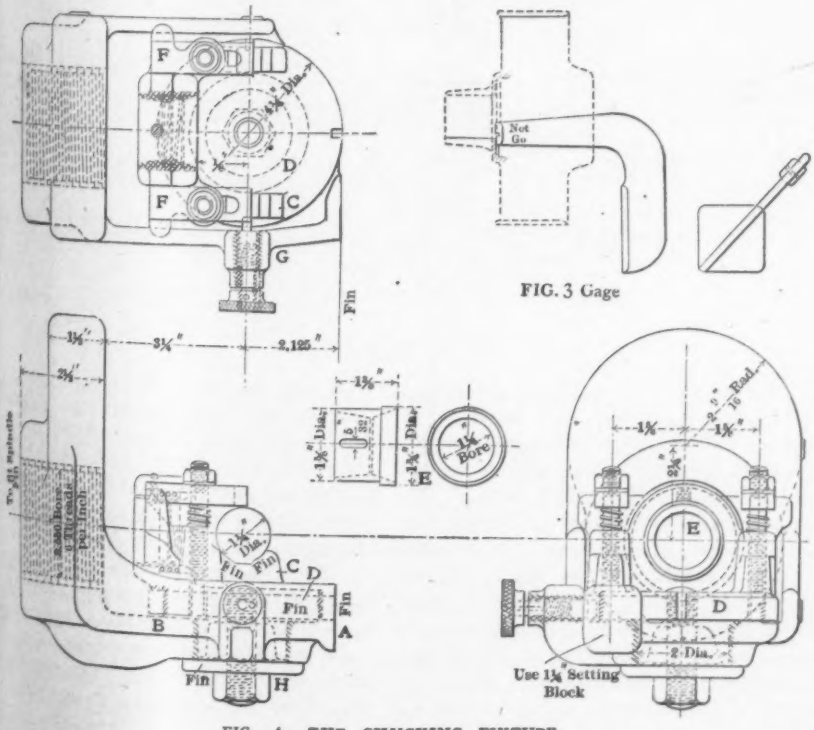


FIG. 4. THE CHUCKING FIXTURE.

The several operations for boring, reaming and facing are shown in Fig. 2 along with the special tools and are as follows:

1. Rough out holes *a* and *b* and face at *e*.
2. Ream holes *a* and *b*.
3. Finish face *e* (to gage shown in Fig. 3) and face at *f*. For the purpose of facing *e* to the correct distance from the center of the piece as shown in Fig. 1, a face *A* is provided on body *B* of the fixture shown in Fig. 4 upon which to set the gage shown in Fig. 3.
4. Face at *g* and *h*; for this operation the operator sets his tool to a ¼-inch setting block which he holds against the face *A* of the fixture just referred to.
5. Rough out holes *c* and *d*.
6. Ream holes *c* and *d*.

The pilots on the boring and facing tools fit a bush in the lathe spindle for steadying and guiding the tools while cutting. The construction of the special fixture for locating and holding the work will be understood from Fig. 4. The shoes *C* on the swivel plate *D* locate the work laterally and vertically, being machined out

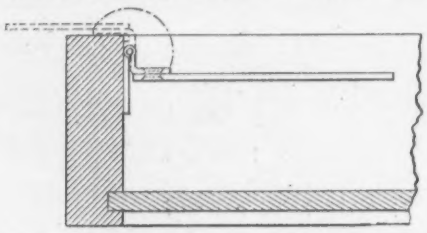
to fit the piece at *k k*, Fig. 1, and the hardened steel bush *E* locates it centrally. This bush can move either inward or outward in its seat (being forced outward by the spring behind it) to allow for any variation in the diameter of the castings; it is prevented from coming out of the hole by the reduced end of a headless screw engaging in a 5/32-inch slot formed in the surface of the bush. The straps *F* are for clamping the work tightly in position on the plate *D*. There are four notches accurately milled at right angles in the periphery of this plate and fitting which is the spring plunger *G*. This is made a good working fit in a hardened steel bush driven tightly into a hole in the body of the fixture. The plunger is forced in the index notches in plate *D* by a spring as shown. This indexing arrangement enables the work on the swivel plate to be brought to its correct position for the several operations of boring, reaming and facing. The plate has a hub turned to a working fit in a hole bored in body *B*, and is clamped firmly by nut and washer at *H*. The nut is of course slacked back on the stud when it is desired to rotate the plate. The fixture complete is screwed tight on to the nose of the lathe spindle.

G. F. Popplewell.

Syston, England.

Holding Drawings Flat in Drawers.

One of the most annoying things to contend with in the drafting room is the tendency of drawings to curl up in the drawers. What is more irritating than to pull out a large drawer from the case and



HOLDING DRAWINGS IN PLACE IN THEIR DRAWERS.

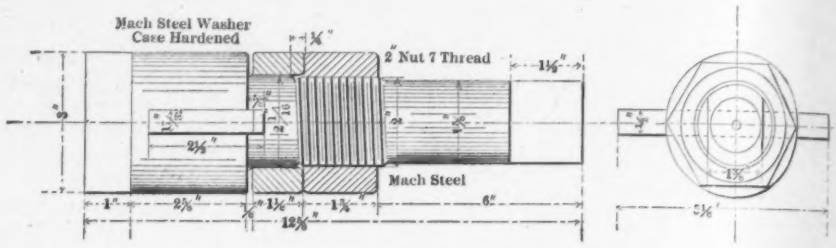
have the top drawing catch and slide over the back side, partially dropping down behind the drawers below, and to find the others all curled up in front?

Not long ago, while working in a large drafting room, where all drawings are made on bond paper and used constantly for reference, I was called upon to design something which would hold the drawings down hard, hoping it would also take the curl out of them at the same time. The attachment I designed is clearly shown in the illustration. It consists of pieces or strips of No. 20 or 22 sheet iron 3½ inches wide, with brass hinges riveted to them, the whole being screwed to the front of the drawer. The hinges were bought with screw-holes in one half, the other half being left blank for drilling to suit rivets, the hinges being first bent in a cheap fixture. This arrangement was applied to drawers of all sizes, ranging from 9 to 60 inches in length, and proved to be very satisfactory.

E. W. D.

Mandrel for Turning Boring Cutters.

The drawing shows a mandrel for holding steel to be formed or turned to cut-



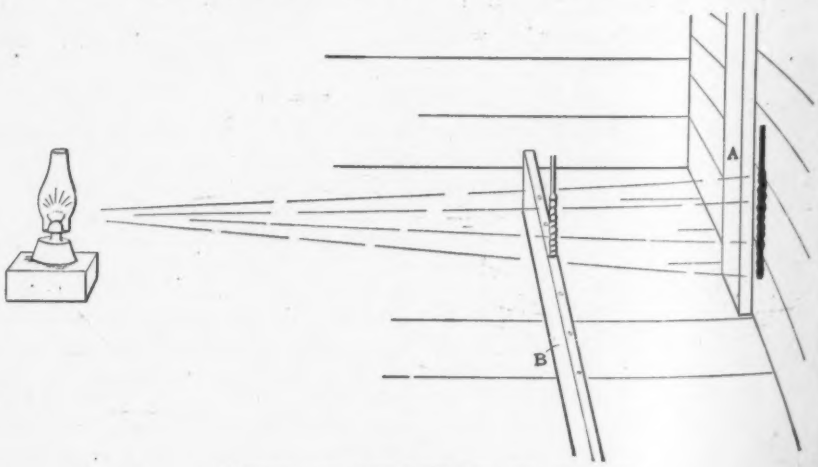
MANDREL FOR TURNING BORING CUTTERS.

ter-bar sizes for boring car wheels on a Niles 42-inch mill. It is an improvement over the style with key arrangement. The bar is slotted $\frac{7}{32} \times 2\frac{5}{8}$ inches and the hardened-steel collar presses the cutter square on the bottom of the slot, insuring its being true with the centers.

H. F. Killean.

Alining an Auger-Bit by its Shadow—Making a Rough Core-Box—The Design of Commercial Printing.

Having occasion to make a piazza gate which would not warrant expending too long a time nor taking to a shop with



ALINING AN AUGER-BIT BY ITS SHADOW.

power, I found the following a convenient and quite accurate way of boring the holes vertically. The lamp shown in the sketch was placed so that the flame was edgewise toward the bit and far enough away to make the shadow sharp. When the edge of shadow coincided with edge of the upright *A* and the bit stood in a plane parallel to the wide surfaces of the board *B*, which latter was easily shown by placing a second lamp in the corner of the room, lighting the side of board opposite the first lamp, the holes were speedily bored.

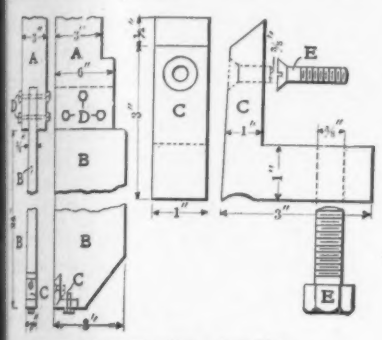
When a casting or two requiring a round rough core-box, is wanted quickly, the use of an expansion bit is frequently convenient. The two halves should be passed over a bench saw or cuts made with a hand saw so that each piece will be cut in depth equal to half the thickness of saw. After placing the grooves together the spur of the bit will, with reasonable care, follow in its proper course.

The "look pretty" idea should no more be the first consideration in our printing than in machine design. Most printing is well enough arranged for looks but we find too little writing space in one part and too much in another. Many bill heads are so arranged that the address cannot be found at once. The date of the bill, order, shipment; home, foreign, branch offices; works, warehouses, terms, business, etc., etc., are too often indiscriminately intermixed, and perhaps finally at extreme bottom appears the P. O. Box number. Many, even in small places, omit the State from the address on their letter and bill heads, seemingly with the thought that their town is the center of the universe, the sun rising twenty miles east and setting the same distance to the westward. This is especially perplexing to the foreigner who would far rather find "U. S. A." added than the State omitted. It would save many hunts in the waste basket for the postmark. These same ones, in acknowledging receipt of a remittance, send us a sheet of printed matter telling us principally about the care given orders, etc.

Let us eliminate work for those who read our printing rather than those who do our printing. "AMA."

A Slotter-Tool Holder for Large Work.

The sketches show a slotter-tool holder for large work. I have used it for cutting off large gates—up to 24 inches depth of cut—on steel castings. I also have a shorter blade for smaller work. The tool



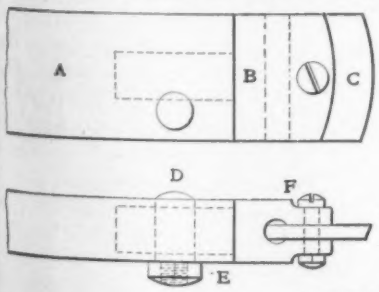
A SLOTTER-TOOL HOLDER.

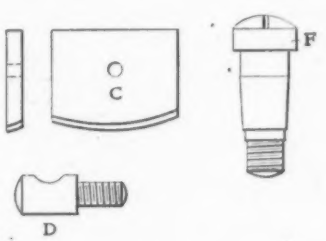
is very stiff and gives excellent results. It can also be made at very little cost.

The sketches are, I think, self-explanatory. *A* is the tool holder, made of machinery steel. *B* is the blade made of tool steel. *C* are the cutters also made of tool steel. The three bolts *D* are driven bolts in reamed holes. To the right the cutters *C* are shown enlarged, together with the flat-head screw and tap bolt *E*, which hold them in place. When a cutter becomes dull it is easily removed and a sharp one substituted. C. W. T.

A Finishing Tool.

In the enclosed sketch, *A* is the body of the tool, *B* is the swinging head and *C* is the cutter. A hole is drilled and





A FINISHING TOOL.

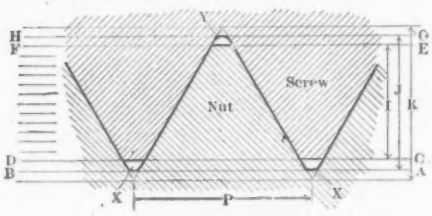
reamed in the end of *A* for the shank of the cutter, the latter being set at any angle to give more or less shear as required. The tool is held in position by clamp bolt *D* and nut *E*. Clamping screw *F* is shown enlarged in the detail. The taper portion seats cutter *C* firmly against the round bottom of the slot in head *B*.

I designed this tool for the purpose of doing away with forging. We took a bar of annealed "gold label" Syrian steel of suitable dimensions to make cutter *C*. It was planed up to proper width and thickness, cut into lengths, and a jig made to locate the hole. The cutters made of this steel and ground on a wet grindstone (not abused by grinding dry on an emery wheel) give perfect satisfaction. E. W. NORTON.

Metric Screw Threads.

In view of the fact that I am greatly interested in the accurate measurement of screw threads, and that with each year the need increases for a better knowledge of the practical side of the metric system, I wish to say a few words about the metric screw thread, hoping they will come to the notice of some who may be as deeply interested as myself.

The facts as already established are briefly as follows: In 1889 the Zurich Congress (so-called) adopted a set of rules, giving a list of sizes and pitches, both in millimeters, and making the *working* part of the thread the same in shape and proportion as the Franklin Institute or United States standard thread, but leaving rather



METRIC SCREW THREAD.

poorly defined its ideas about the contour of the top and bottom of the thread. To quote from the resolutions of the congress: "The clearance at the bottom of thread shall not exceed 1/16 part of the hight of the original triangle. The shape of the bottom of the thread resulting from said clearance is left to the judgment of the manufacturers. However, the congress recommends rounded profile for said bottom."

To help make this clear let us refer to the diagram. The thread in the nut is tapped out or otherwise cut to the line *AB*, while the diameter of the screw stops at *CD*; also the inside of the nut is reamed to the line *EF*, while the bottom of the thread on the screw is at the line *GH*.

Thus it will be seen that there is a clearance *X* at the top of the thread and *Y* at the bottom, each equal to 1/16 of the hight of the original triangle, shown at *K*.

The real or working hight *I* is equal to ¾ that of the triangle, the formula (hight = pitch × 0.6495) found in engineers' handbooks, being derived as follows: The angle of the thread being 60 degrees, its sides are two sides of an equilateral triangle, and the total hight *K* equals *P* (pitch) × 0.866, and *I* (see diagram) equals ¾ × 0.866 × *P*, or $I = 0.6495\,P$.

One thing worthy of note in this connection is that the term pitch as applied to the metric thread is used in its right sense, while the term as we commonly use it denotes the number of threads per inch and not, as it rightly should, the distance between convolutions of the same thread.

These "rules" regarding the metric thread are such as the Zurich Congress wished to become universally adopted, and while I am not in a position to know just how many manufacturers of screw-cutting tools have adopted them, I have a feeling that perhaps some may be even as I am thirsting for more information on this subject.

Referring again to the diagram, it will be seen that, while to get the required thread in the nut, the diameter of the tap must extend to *AB*; still, if the tap were accurate to diameter as measured on the angle of the thread, and on the outside as well, the diameter need not extend beyond *CD* to get a thread in the nut that will fit that of the screw.

And as most tap manufacturers of today recognize the importance of taking measurements on the angle of the thread, it seems an open question as to the wisdom of weakening the screw and nut by leaving so large a space at the top and bottom of the thread which has no purpose but to provide for inaccuracies of manufacture.

If this article shall come to the notice of those who have to make tools for cutting metric screw threads, and shall provoke an interest that will ultimately lead to the adoption and general use of a standard form for the same, then I shall feel that its mission has not failed.

Greenfield, Mass. O. S. BICKFORD.

The Minimum Diameter of Wire Rope Sheaves.

Referring to E. R. Plaisted's remarks at page 353, on the subject of wire hoisting ropes, and the minimum size of sheaves for them, I have taken the tables published in the pocket books as giving the minimum sizes of sheaves for power transmission work. A rope running continuously at a very high velocity is subject to bending action in passing over the sheaves many times oftener than is the case in derrick or crane work, such as referred to by Mr. Plaisted. Hence, to avoid very rapid wear, it is necessary in the former case to make the sheaves much larger than in the latter.

A minimum diameter of sheaves of twenty-four to forty times the rope diameter represents the usual practice in hoisting and conveying machinery; and

in places where space is limited still smaller diameters may be necessary. Some sacrifice of durability of rope is made for the gain in convenience due to using smaller diameters.

In this connection the following data, from a recent magazine article describing the hoisting machinery in the Original mine at Butte, are of interest, as throwing some light on hoisting practice in deep mines.

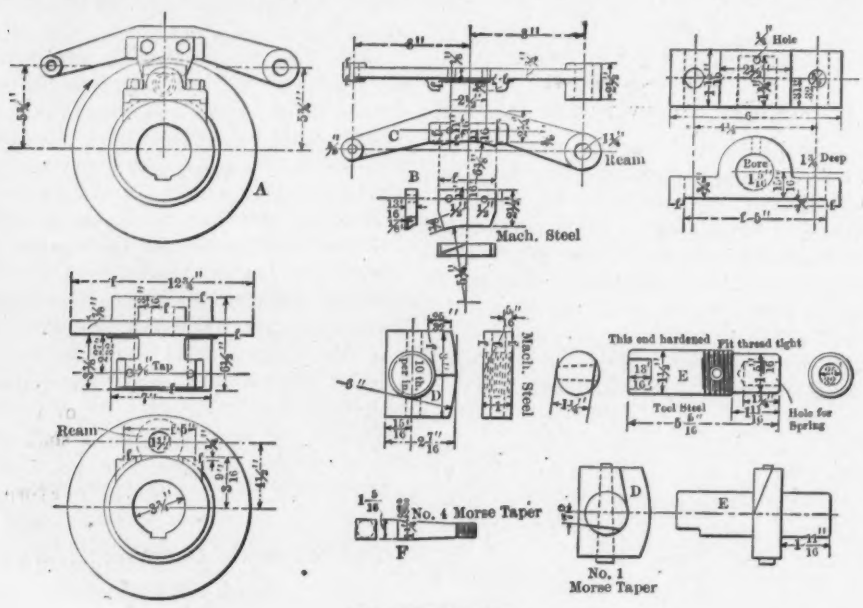
The depth of the shaft is given as 2000 feet. The hoisting rope is round, 1½ inch diameter, has 6 strands of 19 wires each, with hemp center, and carries a working load of 13 tons.

The diameter of the drum is 12 feet, and of the overhead sheaves 10 feet, the latter therefore being 80 times the diameter of the rope, or about double the size that would be considered ample in an ordinary derrick. The life of the rope is given as from 12 to 18 months.

A. L. WESTCOTT.

A Stop Clutch for the Power Press.

The drawing herewith shows a simple form of clutch of the sliding bolt or pin



CLUTCH DETAILS.

class commonly used on stamping presses where it is desirable to have the ram stop at the upper end of its stroke, when the treadle or operating lever is released. An assembled view is given at *A* and the rest of the sketches are working details. This has proved a very durable and efficient clutch for speeds not exceeding 60 revolutions per minute for the size here shown. The inclined surfaces of the wedge *B* on the lever *C* and the block *D* on the pin *E* should be shaped as if they were the sides of a square thread cut ¾-inch deep on a screw 12 inches in diameter with a pitch of the angle shown. Those I have seen were shaped approximately as flat surfaces, and afterward finished by hand to the markings shown by rotating the shaft and clutch in the press as if they were in actual service. The helical spring which actuates the bolt *E* should have about 16 coils of 1/16-inch spring-steel wire made to a free hight of about 2¼ inches.

The square-head, taper-body pins *F* are fitted into the holes in the driving wheel, the square head projecting ¾ inch. The centers of the pins are 4½ inches from the shaft centers, and there may be three or four as preferred. Some makers of this kind of clutch prefer to leave the engaging end of the sliding bolt round, and instead of having the pin heads in the wheel square, they are made round and large enough to have four notches formed in each head with a mill of the same diameter as the sliding pin. This makes the latter somewhat stronger, but I prefer to make it of such a diameter that it will be strong enough for the purpose after being flatted on one side, for it is then easier and cheaper to repair when it gets worn too much to hold securely, as also are the square head pins. One special merit this clutch has, is that the friction of the wedge on both sides, due to the resistance of the spring, makes a sort of friction brake to stop the shaft as soon as the clutch disengages. The square-head pins may be made of soft steel with the heads case-hardened, or of tool steel tempered, as preferred. Where not otherwise stated the details are made of gray iron. The weight of the lever and wedge is usually enough to cause the lever to drop into position as soon as the treadle is released, but if the treadle partly counterbalances the lever the latter should have a spring or weight attached to its outer end. to make it act promptly. It may sometimes be more desirable to have the wedge-lever on the lower side of the clutch, and it is obvious that the lower pivot may be placed at any convenient direction from the center of the shaft. In some cases instead of the wedge being carried on a lever it is secured to the end of a bar which is so guided as to have a radial movement to the shaft center. When the working head of the press is not counter-balanced, the periphery of the flange on the clutch offers a good surface to which a friction brake may be applied to prevent the head from dropping on the down stroke.

BELL CRANK.

System in the Drawing Office.

While systematic methods in the machine shop are generally appreciated, the importance of system in the drawing office is too often lost sight of, not only in small shops, but many times in larger ones of several hundred men, where the drafting-room force is small. Too frequently there is a rush to get out a particular drawing which is not in the regular course, and while the regular manufacturing drawings are filed in more or less systematic manner, special and experimental drawings and sketches and tool drawings are put into drawers or left on a table with many others, and if later there is a call for a particular drawing of this kind, no one knows just where to find it, or just when it was made, unless the man who made it carries the matter in his memory.

Where a man has been in the drawing room for a considerable length of time, often his memory or his note book will furnish some data, but if changes are going on all the time, it is essential that all record drawings and data sketches should not only be known to exist, but their location should be known, so that anyone who has use for them can find them. Drawings used in regular manufacture may, perhaps, be readily found, but the designer requires more than these for quickly getting at data on different parts of a machine, and different sections of the machine giving particular dimensions that he may need, are of great value when making a change in any part, and if they are in existence, should be readily available, otherwise he must go over ground to get the necessary accuracy. The designer does not waste much time in details when he lays out a data sketch, and generally it consists of a few lines and dimensions, with an occasional part shown in detail. That is all; no title, nothing to show what it is to the man who, six months or a year later, wishes to use similar data, perhaps for an entirely different purpose. If the man who originally laid out the sketch is about, he may know where it is, if he is asked, but it is much more likely to be the case that it is not thought of, and much of the same work is gone over again. This can hardly be charged to a slipshod method *per se*, but rather to a lack of proper appreciation of the importance of keeping *every* drawing or sketch where it may readily be found, and a record of every such sheet, so that

anyone can find out readily what there is on the subject.

In many establishments the drawing room is not looked upon as a department, but rather as an adjunct to the office or to the shop, as the case may be. This is particularly true of small concerns, with one or two draftsmen, and it often is the case that a draftsman is engaged for a short time with the expectation that the work will be completed, and no further need of such work experienced. With growing concerns, however, the estimated time proves far too short, as improvements will be constantly made, until the man who came for a few weeks or months, continues on indefinitely, and becomes a factor in the success of the work. It is in such cases that lack of system is apt to be most pronounced. Starting with a few sketches and drawings, which he recognizes almost by the feeling, the draftsman alters, discards, or puts away the results of his work, and for a time can readily find anything he wants. Imperceptibly there comes a time when it takes a little hunting to find the right thing at the right time. He may realize that he needs some way whereby he can readily lay his hand on the right sheet, but it is seldom that he can take the time at once to improve matters. And so the evil continues and increases. When he does get at it, the shop drawings are the first and perhaps the only drawings filed systematically, sketches and data being left without filing. From the nature of the case, these must be kept apart from the shop drawings. It is not always convenient to keep them down to standard-size sheets, and moreover they are generally in pencil; in fact are simply for reference. Each sheet, however, should be given an identifying title and number, and then recorded.

Where convenient, it is better of course, to use standard sizes of sheets, but if a part or group is 20 inches long and only two or three inches wide, as often occurs in checking up a length, it goes against the designer's grain to use a sheet, say 16x24 inches. These sheets may be approximately grouped on the A B C principle, however. Say the basis is a 22x28-inch sheet. If that is known as an *A* sheet, a 14x22-inch may be a *B*, an 11x14-inch a *C* sheet, and an extra size above the *A*, an *A A*. If a drawing is, say 6x20 inches it would be 6x10 inches doubled over, and could be readily identified if given a *D* number, which would be normally, 7x11 inches. By filing in some such manner, much time is saved, and much unnecessary calculating avoided, with the additional benefit that a designer unfamiliar with the particular machine may readily proceed with his design, with data at hand that have been prepared by one who has been over the ground. Drawings of jigs and fixtures are generally simple pencil drawings, as they are seldom used a second time; enough are used, however, when a part is changed, to warrant filing away for reference. It is unnecessary to have an elaborate record of these, often only the character of the operation being required to locate readily any jig or fixture. Each sheet may be titled, numbered and recorded in a few minutes, and then if several years after, the drawing should be required, the man who filed it is apt to be silently blessed for the "red tape" he used at the time. The sheets may be of standard sizes, with an identifying letter different from the regular drawings, to show that they are tool drawings.

This method is used in some large establishments, and is very satisfactory. In the same connection, sketches which are sent away should always have a record kept. It is not always convenient to trace and blue-print these sketches, and often there is not time to do so, but it is not safe to send a drawing away without leaving a duplicate behind. A carbon or a letter-press copy gives this, and may be filed where it can be referred to. With shop or manufacturing drawings there are often a number of prints that leave the drawing room, and some method is essential that will make it certain that all drawings out are up-to-date.

Where several departments have each a file of drawings, each change should be noted at once by the drawing room, either by a new print, or, when only a figure or line is changed, by making such change in ink.

Pencil changes should be strictly tabooed; unless they are. trouble is sure to result sooner or later, for some time a mistake is going to be made and the man who is responsible for the drawings is the one who will be blamed. As these alterations occur continually, and as it usually happens that the draftsman can not at once take up every change on every blueprint, as well as the original, a convenient way of keeping track of changes is to have a card for each one, describing it and who is responsible for it. These cards may then be taken up as soon as possible, and when the changes are completed on tracing and prints, and the date jotted down, the card may be filed away as a permanent record of the particular drawing. Due care should be taken that all drawings of a part be called in as soon as a change is decided upon, and then if the drawing is required before the changes are complete, the one who requires it must go to the drawing room for the corrected print. This not only simplifies the draftsman's work, but a standing record is kept of all changes which have occurred, and why, and any one who has been through it can remember the times that the question has come up long after the matter was forgotten as to the reason for a particular change.

When the answer is not forthcoming, excuses are not satisfactory, and after the matter is thought out and explanation given, one is always apt to feel that the verdict is "not guilty, but don't do it again." A record should be kept of each print that leaves the drawing room, with the date, and no duplicate should be issued to the same man unless the first is accounted for, and its whereabouts noted. This is essential, as old drawings with out-of-date dimensions have an inconvenient way of turning up in the wrong place, if they are not carefully looked after.

For checking the responsibility for changes, it will be found of value to require the one who orders a change, to put it in writing and sign it; then if, as sometimes happens, it does not pan out as expected, there is a record aside from the draftsman's own file. Moreover, if this rule is strictly followed, the troublesome question is not asked, "Don't you remember I told you? etc." No drawing room is too small for a system suited to its needs, and the larger the department, the more necessary that there should be only enough system to facilitate the work. The charge of "too much red tape" is a common one with large establishments, and is no doubt justified in some cases, but the accuracy of manufacture depends on the correctness of the drawing from which the work is made, and every safeguard the drawing room can make, within reason, takes just so much from the manifold duties of the one responsible for the department, and everything eliminated from his memory and placed on record not only does not detract from his value, but from the greater facility with which he can locate each point, or answer each question, it adds to his capacity for handling the details, as well as the broader lines of his work. The time spent in following out a system on the lines suggested, is slight if regularly followed; the saving in worry, and the ability to find what is wanted, and at short notice, amply repay one for the effort involved.

FRED W. MCARDLE.

Should a Machinist Sit While Working?

I have read with a great deal of interest the articles in the AMERICAN MACHINIST, with regard to machinists sitting while working.

In my travels I have found, to my own satisfaction, that men should not be allowed to sit while working, except in cases where the work can be performed better and with more ease, and also with an increase thereby in the quantity of work turned out; planer and shaper work, for example.

The principal trouble is that men in general will take advantage of the privileges given them, and when given the privilege of sitting at their work they invariably get lazy and neglect their work, some intentionally and some, no doubt,

unintentionally. I think when a man is paid to run a machine he should not expect to be furnished with the luxuries of a home, but should stand up and perform his duty. I remember one man who took advantage of his shop foreman by sitting peacefully on his box while drilling a 5/8-inch hole, using the back gear and the slowest speed, and for no reason except that he was too lazy to get up and do his work as it should have been done; yet he was a first-rate sort of a fellow, and intended no wrong by so doing.

I am sure the output of a shop is materially decreased by permitting seats in a factory, and I allow none in the shop unless in places where they can be used to special advantage. I never went into a shop where seats were provided for the workmen, but what an air of laziness pervaded the whole institution, and in my judgment, seats are responsible for much spoiled work and many defaced chucks.

I do not agree with E. E. Wood's article at page 254, for my experience has taught me exactly the opposite to his theory. I would like to hear from others on this subject. J. FRANK RICHMAN.

Bending Bolt Bodies.

The sketches show how I made some bolt bodies. Cast-iron bodies are of little protection, as they are so easily broken, and the wrought ones are usually made of two or more pieces riveted together. The bodies that I describe here can be made of a single piece of strip steel or brass; there being no riveting, they could be made very rapidly with suitable dies on the power press. As I only wanted a few of them, I made forms to be used in the vise to bend the strips into the desired shape after the holes had been punched in them. Fig. 1 shows a top and side view of the complete bolt, in which *B* is the body, *C* the bolt, *E* the bolt knob and *A* the keeper.

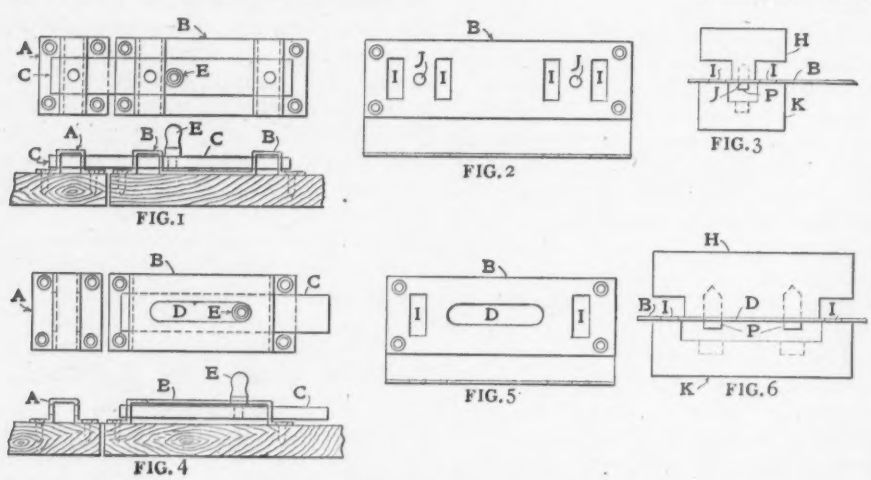
Fig. 2 shows a piece of strip iron cut to length, having the required holes punched in it. The four oblong holes indicated by *I* are the openings through which the bolt *C* works after the strip *B* is bent to shape; the bending shows the oblong holes perpendicular to the top and bottom of the body.

The bending is done by the forms shown at Fig. 3, which shows the strip *B* between them, the pin *P* on the form *H* passing through the hole *J* in the strip *B*. The object of this is to make sure that the holes *I* come opposite one another after the bending. After this bend is made the strip *B* is turned end for end and the other end is bent. There being two bent-up portions, the knob *E* on the bolt *C* works between them, the bent-up portions acting as stops at either end for the bolt *C*.

Fig. 4 shows a top and side view of another form of body, which has only one bent-up portion. It requires only two oblong holes *I* for the bolt *C* to slide in, but in addition to this it requires the oblong hole *D* for the knot *E* to slide in.

Fig. 6 shows the bending forms for this body, in which *B* is the strip, *P* the pins entering the slotted hole *D* gaging the strip *B* while it is being bent so that the oblong holes *I* come opposite one another after bending. The bolt keeper *A* is made in the same way.

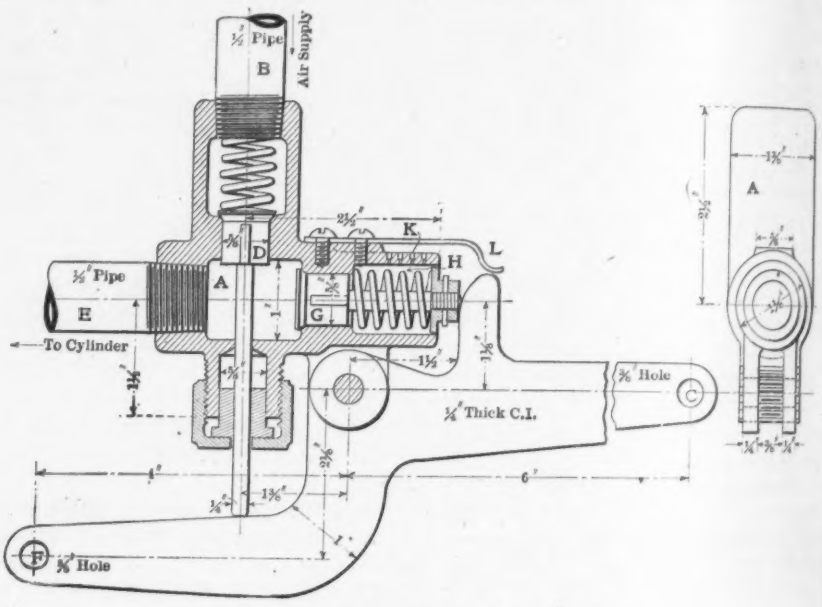
As these bends do not have to be sharp, the forms can be loose fitting, so there will be no danger of the metal breaking in bending. C. W. J.



BENDING BOLT BODIES.

Operating Valve for an Air Hoist.

I had occasion to build several air hoists recently for use in various departments of our works. These hoists were of the single-cylinder straight-lift type, the cylinders being made of 4½- and 6-inch thin tubing of various lengths, four feet being the usual lift required.



OPERATING VALVE FOR AN AIR HOIST.

The principal parts of these hoists were the operating valves, which are illustrated in the accompanying sketch. They have proven very satisfactory.

The body *A* is a brass casting with the air inlet through the ½-inch pipe *B*. To cause the hoist to lift, the hand rope which is attached to the opperating lever at the hole *C* is pulled downward, thus lifting the valve *D* from its seat; the air then passes through the valve *D* into the chamber *A* through the ½-inch cylinder pipe *E*, which leads to the under side of the hoist piston. When the load is raised to the required hight and it is desired to lower it, the hand rope at *C* is released and the valve *D* will fly down upon its seat, where it is held by the coiled steel spring and the pressure in the supply pipe; the load will remain at this hight until released, provided there are no leaks. To release the load, pull the rope attached at the hole *F* in the lever, thus pushing the exhaust valve *G* from its seat. The air in the hoist then passes out through the pipe *E*, the chamber *A*, the valve *G* and the chamber *H* to the atmosphere through the small perforations *K* which muffle the exhaust. The exhaust valve is held on its seat by a coiled steel spring; this spring also assists the 1/16x½-inch flat steel

spring *L* in keeping the operating lever in a horizontal position. BAYARD.

California.

A Locomotive Lifting Beam.

Fig. 1 illustrates a forty-ton locomotive lifting beam which is found to be a necessary article in the locomotive erecting and repair shops. This beam is used in lifting the assembled or partly assembled locomotive in connection with the traveling crane. The crane hook is connected at pin *A* in the top of cross bar *B*. The side frames of the locomotive at the cab end rest on the bottom cross bar *C* at points *D D*.

The ends of the vertical lifting rods are fitted with keys *E* pitched 10½ inches apart to give adjustment for lifting the smaller or larger machines. The tool is hung on the side wall of the shop as high up as is convenient for the crane hook, thus taking up none of the valuable floor space. The front end of the locomotive is lifted with the sling chain shown at Fig. 2, the double hook *G* was made in order to take the strain of the two ends of the chain pulling in different directions from the crane hook. This sling is about 26 feet in length with the large links *H* on each end. This double hook is considered very much safer than throwing both ends of the chain directly in the crane hook. BAYARD.

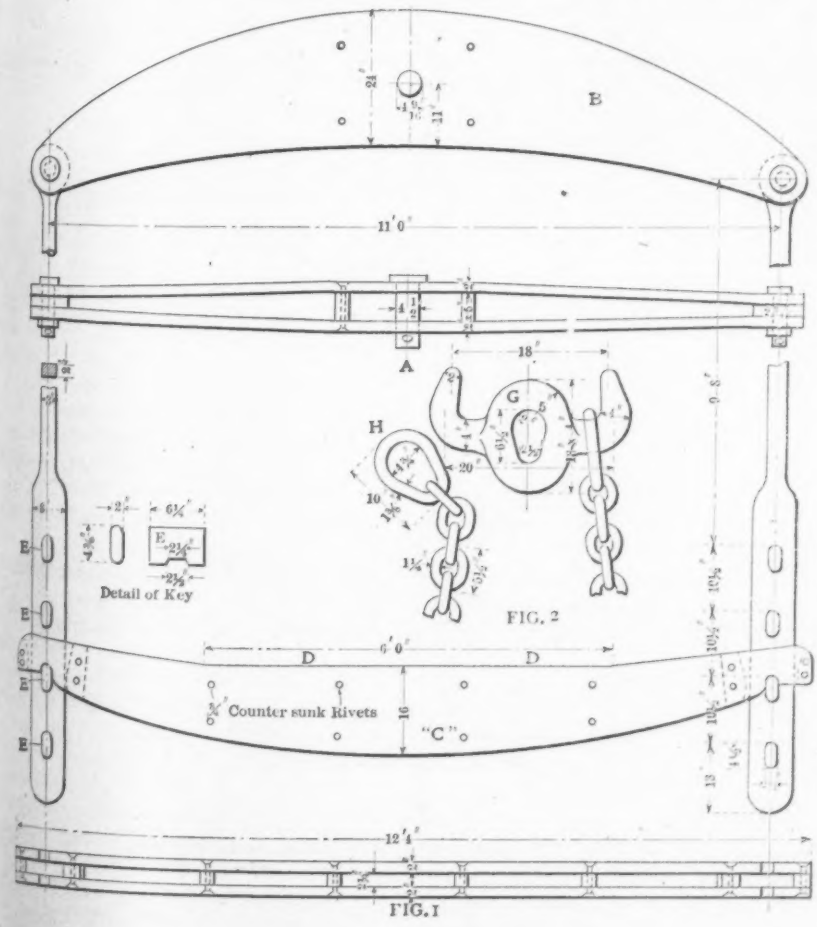


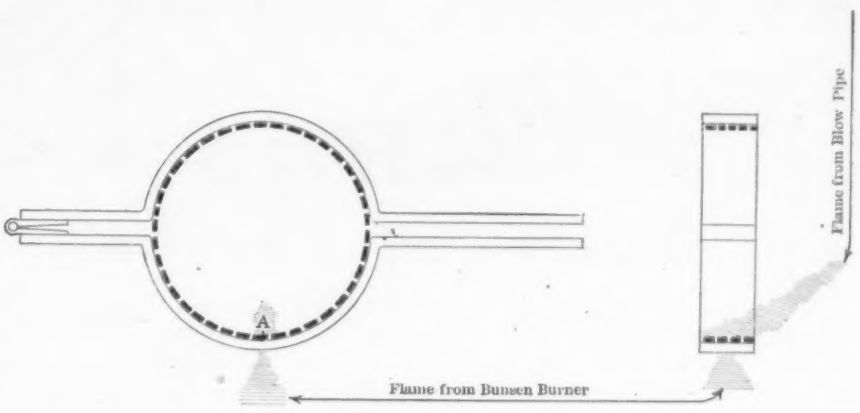
FIG. 1

A LOCOMOTIVE LIFTING BEAM.

Brazing Light Work.

The sketch shows a method of brazing light work. The work shown by the dotted lines in this case is a light brass ring about two inches diameter, ½ inch wide and 1/32 inch thick. The ring is held together in the fixture made of flat iron about ⅝x⅛ inch. Under this fixture is a bunsen burner, which keeps the work and fixture hot, but does not melt the brazing compound. The flame from a blow-pipe is brought in contact with the joint at *A*.

The way many do brazing is to have the work lie on a fire of pea coal, which does the work of the bunsen burner. I think the first method is the best, as it is cleaner and handier, and a blow-pipe is used in both cases to melt the brazing compound. In this case I made no provision to prevent the brass from adhering to the iron, as I found it had no tendency to do so. But in cases where it is apt to do so, the inside of the iron clamp may be painted with graphite, or covered with asbestos. HERMAN JONSON.



BRAZING LIGHT WORK.

Safe Load on Chains.

At page 384 you say "The diameter of the iron in the link in eighths, squared and divided by nine, gives the safe load in tons for chains." This, according to Kent and the Admiralty proof tests, would give but about two thirds of the safe working load and necessitate superfluously heavy chain. In its stead I submit the following rule: The diameter of the iron in the link in sixteenths, squared and multiplied by eighty, gives the safe load in pounds for chain.

This is readily shown by the following comparison:

Diameter.	Proof Test.	Safe Load "Kent."	"Moore."
¼" = 4/16	1,680	1,288	1,280
5/16" = 5/16	3,040	2,790	2,880
6/16" = 6/16	6,720	5,182	5,120
7/16" = 7/16	10,360	7,942	8,000
½" = 8/16	15,120	11,592	11,520
9/16" = 9/16	20,440	14,989	15,680
1" = 10/16	26,880	19,712	20,480
1 1/16" = 11/16	34,160	25,030	25,920

This eliminates all algebraic formulas with which the average person is not familiar and arrives at practically the same results. GEO. R. MOORE.

Supt. of Shops, University of Colorado.

The late T. R. Almond was one of those whose counsel was sought in the establishment of the AMERICAN MACHINIST and his business has been represented in its advertising columns without intermission since the first number of the paper. He was one of its most regular readers and an occasional contributor.

The Japanese naval authorities have decided to adopt Parsons' steam turbine machinery for the two new battleships of 19,000 tons, one of which has already been laid down at the Yokosuka yard, and the other to be presently commenced at Kure.

Some Notes on Motor Driving.*

BY W. J. BELSEY.

On the whole the author thinks that the continuous-current motor is the best suited for engineering works and foundries as variable speed may be desired, and is in some cases essential. It may be taken as a fair general rule that in an engineering works it pays to drive any machine requiring over five horse-power individually.

A few tables as to the size and rating of motors used on the various machines in general use in engineering works may be of interest, and the author therefore gives the same below:†

Hight of Center. Inches.	Distance between Centers. Inches.	Rating of Motor. B. H. P.
4½ to 6	20 to 32	¼
7 to 8½	36 to 80	½
8½ to 12½	40 to 100	1
14 to 16½	100 to 140	1½
16½ to 19	140 to 175	2

LATHES FOR SCREW-CUTTING AND GENERAL WORK.

Diameter of Face-Plate. Inches.	Largest Working Diameter. Inches.	Rating of Motor. B. H. P.
36 to 50	48 to 64	2
60 to 63	64 to 93	3
80 to 100	106 to 140	5
158	212	10

FACE LATHES.

Hight of Center. Inches.	Largest Work'g Diameter. Inches.	Greatest Work in Length. Inches.	Rating of Motor. B. H. P.
9	20	33	1
11½	24	43	3
11¾	25½	33	2
13	28	55	5
16¾	34	63	5

TURRET LATHES (WORKING WITH ONE TOOL).

Diameter of Table. Inches.	Greatest Working Diameter. Inches.	Rating of Motor. B. H. P.
50	51	2
68	84	3
82	96	5
83	120	5
156	300	15

VERTICAL BORING MACHINES.

Greatest Hight of Bar. Inches.	Largest Working Length. Inches.	Rating of Motor. B. H. P.
21 to 25	40 to 60	1½
33 to 35	80 to 140	2

HORIZONTAL BORING MACHINES.

Pattern.	Maximum Diameter of Work on Table. Inches.	Greatest distance from Spindle End to Table. Inches.	Rating of Motor. B. H. P.
Quick speed...	6 to 10	9 to 35	½
Pillar.....	10 to 13	32 to 48	1
Radial.....	40 to 72	46 to 80	2
Three-spindle.	5 to 6	31 to 35	1

DRILLING MACHINES.

Pattern.	Dimensions of Table. Length. Inches.	Breadth. Inches.	Greatest Distance from Spindle to Table. Inches.	Rating of Motor. B. H. P.
Universal (medium)..	30	5	12	1
Ditto (heavy).	58	11	22	1
Vertical and Straight....	70	14	22	3
Ditto.....	120	52	44	5

Wheel-cutting machine for wheels of 20 in. to 48 in. diameter, 2 B. H. P. Ditto for wheels up to 55 in. diameter, 3 B. H. P.

MILLING MACHINES.

Diameter of Emery Wheel.	Rating of Motor.
Up to 10 in.	½ B. H. P.
10 in. to 14 in.	1 "
14 in. to 22 in.	2 "

GRINDING MACHINES.

To Plane in Length. In.	To Plane in Width. In.	To Plane in Hight. In.	Rat'g of Motor. B. H. P.
40	26	26	1
72	24	24	1½
84	26	24	3
120	38	38	5
120	49	49	7½
168	60	60	10
192	73	73	10
206	105	105	10

PLANING MACHINES.

Length of Stroke. Inches.	Traverse of Head. Inches.	Great't Underside of Ram to Table. Inches.	Distance from Rating of Motor. B. H. P.
4½	15	8	½
16	30	20	1
20	20	20	1
25	25	26	1

SHAPING MACHINES.

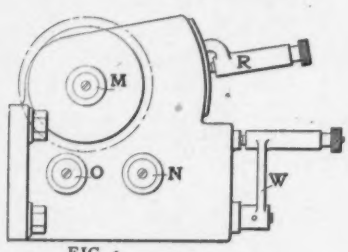


FIG. 1

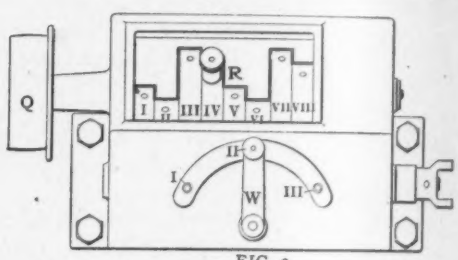


FIG. 2

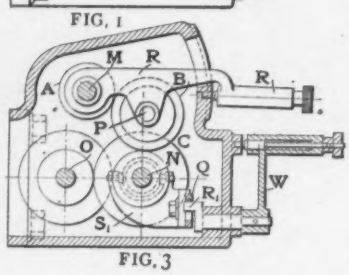


FIG. 3

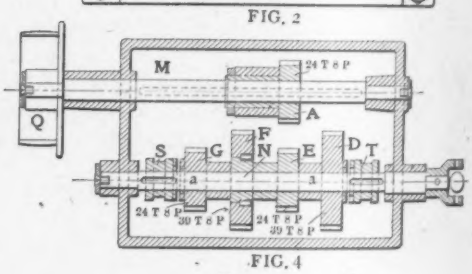


FIG. 4

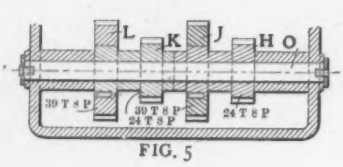


FIG. 5

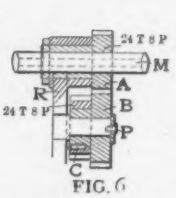


FIG. 6

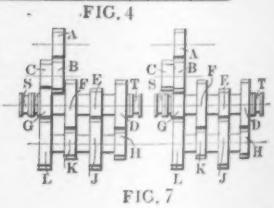


FIG. 7

VARIABLE-SPEED GEAR BOX.

Length of Stroke. Inches.	Width of Slot. Inches.	Depth of Slot. Inches.	Dimensions of Table. Inches.	Rating of Motor. B. H. P.
5	14	12	12 x 12	¾
6	12	9	20 x 16	1
8	20	24	dia. 28	1½
8	30	30	dia. 30	1½

SLOTTING MACHINES.

Weight of Tup. Lb.	Largest Drop. Inches.	No. of Strokes per Minute.	Rating of Motor B. H. P.
330	44	155	7½
550	50	126	7½

DROP HAMMERS.

Weight of Tup with Piston. Lb.	Length of Stroke. Inches.	Number of Strokes per Minute.	Maximum Hight of Work. In.	Rat'g of Motor. B. H. P
165	11¾	220	4¾	3
275	14½	200	7	4½
440	17¾	180	8¾	6½
660	19	170	10¼	8
1,000	21½	150	11¾	10
1,425	23	130	13¾	12-15
1,870	27	110	15¾	17-20

PNEUMATIC HAMMERS.

*Extracted from a paper read before the Dublin section of the British Institution of Electrical Engineers.

†It is proper to remark that the sizes of motors given in these tables seem small from the American standpoint. This becomes especially marked when comparison is made with the figures given in Mr. Campbell's paper published at page 404.—Ed.

Some archæologists assert there was no Copper Age, the transition from stone to bronze having been at once and accidental through using copper ores containing zinc or antimony, tin-copper ores being rare.

Variable-Speed Gear Box.

BY SYDNEY MILLS.

The illustrations show an arrangement of variable-speed gearing arranged in geometrical progression, suitable for a milling or other machine-tool feed gear. Figs. 1 and 2 show front and end elevations of the gear box, the arrangement of gears being shown in sectional views in Figs. 3, 4, 5 and 6.

Fig. 3 is an end section through the box. Fig. 4 is a section through the driving shaft *M* and also through the transmission shaft *N*, which delivers the motion through a universal joint to the machine. Fig. 5 is a section through the shaft *O*, and Fig. 6 a section through the lever *R*, showing the intermediate gears *B* and *C*. The intermediate gears *B* and *C* are driven by wheel *A* and ride loose on stud *P*, which is attached to lever *R*. A set of four gears, *D E F G* ride loose on transmission shaft *N* and are prevented from lateral movement thereon by the two rings *a*, which are fastened by pins to the shaft *N*.

Driving clutches *S* and *T* are both keyed to shaft *N* and alternately engage the gears *G* and *D*, which have corresponding teeth to receive them. These clutches are operated by lever *W* on the front of the gear box. When the spring catch of lever *W* is moved into notch *I* the clutch *T* engages the wheel *D*. By changing the lever *W* from notch *I* to notch *III* the clutch *T* comes out of mesh with wheel *D*, and clutch *S* then engages the wheel *G*. When the lever *W* is moved into notch *II* no motion is imparted, as driving clutches *S* and *T* are both out of mesh with their corresponding wheels *G* and *D*. The lever *W* is connected to the clutches *S* and *T* by a flat bar *Q*, in which is an elongated

hole to receive the eccentric pin *R*. The clutch levers S_1 are both secured to this bar by screws. In this arrangement a total of 16 speeds is obtained—i. e., eight speeds by lever *R*, when lever *W* is held by its spring catch in notch *I*, and 8 other speeds by lever *R* when the lever *W* is held by its spring catch in notch *III*.

The speed list will readily show how the different speeds are obtained. The speeds have a wide ratio of 38 to 1, advancing in geometrical progression.

When the slowest speed is required, the lever *R* must be in notch *II* and lever *W* in notch *I*. The wheel *C* is then in gear with wheel *G* and driving clutch *T* is in mesh with wheel *D*. Gear *A*, which is keyed to shaft *M*, drives the gear *B*, which is fastened to gear *G*, and both gears ride loose on arm *P* of lever *R*. Gear *C* drives gear *G*, which rotates loosely on shaft *N*; gear *G* drives gear *L*, to which is fastened gear *K*, both *L* and *K* rotating loosely on shaft *O*. Gear *K* drives gear *F*, fastened to which is gear *E*, both of which also rotate loosely on shaft *N*. Gear *E* drives gear *J*, fastened to which is gear *H*, which gears with *D*. The clutch *T* is engaged with *D*, which rotates the shaft *N*, from which the motion is imparted to the machine through a universal joint. Two illustrations of the gears and clutches, in their positions for the speeds Nos. 1 and 2, are shown in Fig. 7. A speed list is appended.

Manchester, England.

Speed No.	Posit'n of Lever W.	Posit'n of Lever R.	Gear Wheels.	Gear Ratios.	Revs. of Feed Shaft.
1	I	II	$\frac{A \times C(G) \times K \times E \times H}{B \times (G) \times L \times F \times J \times D}$	$\frac{24 \times 24 \times 24 \times 24 \times 24}{30 \times 39 \times 39 \times 39 \times 39}$	0.114
2	I	I	$\frac{A \times (B) \times (G) \times K \times E \times H}{(B) \times (G) \times L \times F \times J \times D}$	$\frac{24 \times 24 \times 24 \times 24}{39 \times 39 \times 39 \times 39}$	0.143
3	I	IV	$\frac{A \times C \times E \times H}{B \times F \times J \times D}$	$\frac{24 \times 24 \times 24 \times 24}{30 \times 39 \times 39 \times 39}$	0.186
4	I	III	$\frac{A \times (B) \times F \times H}{(B \times F \times J \times D}$	$\frac{24 \times 24 \times 24}{39 \times 39 \times 39}$	0.230
5	I	VI	$\frac{A \times C \times (E) \times H}{B \times (E) \times J \times D}$	$\frac{24 \times 24 \times 24}{30 \times 39 \times 39}$	0.303
6	I	V	$\frac{A \times (B) \times (E) \times H}{(B) \times (E) \times J \times D}$	$\frac{24 \times 24}{39 \times 39}$	0.379
7	I	VIII	$\frac{A \times C}{B \times D}$	$\frac{24 \times 24}{30 \times 39}$	0.492
8	I	VII	$\frac{A \times (B)}{(B) \times D}$	$\frac{24}{39}$	0.616
9	III	II	$\frac{A \times C}{B \times G}$	$\frac{24 \times 24}{30 \times 24}$	0.80
10	III	I	$\frac{A \times (B)}{(B) \times G}$	$\frac{24}{24}$	1.00
11	III	IV	$\frac{A \times C \times (F) \times L}{B \times F \times K \times G}$	$\frac{24 \times 24 \times 39}{30 \times 24 \times 24}$	1.20
12	III	III	$\frac{A \times (B) \times (F) \times L}{(B) \times (F) \times K \times G}$	$\frac{24 \times 39}{24 \times 24}$	1.66
13	III	VI	$\frac{A \times C \times F \times L}{B \times E \times K \times G}$	$\frac{24 \times 24 \times 39 \times 39}{30 \times 24 \times 24 \times 24}$	2.11
14	III	V	$\frac{A \times (B) \times F \times L}{(B) \times E \times K \times G}$	$\frac{24 \times 39 \times 39}{24 \times 24 \times 24}$	2.64
15	III	VIII	$\frac{A \times C \times (D) \times J \times F \times L}{B \times (D) \times H \times E \times K \times G}$	$\frac{24 \times 24 \times 39 \times 39 \times 30}{30 \times 24 \times 24 \times 24 \times 24}$	3.46
16	III	VII	$\frac{A \times (B) \times (D) \times J \times F \times L}{(B) \times (D) \times H \times E \times K \times G}$	$\frac{24 \times 39 \times 39 \times 30}{24 \times 24 \times 24 \times 24}$	4.30

SPEED LIST.

The National Physical Laboratory.

We have before us the report for the year 1905 of the National Physical Laboratory at Keddington, England. This is the institution which corresponds to our newly established Bureau of Standards at Washington, and it performs similar functions. A feature connected with this laboratory, which we believe has not been adopted in our institution, is the organization of what is called a general board (as members of which we find the names of many men who are very well known in America), and who have been appointed as the representatives of the various organizations of engineers, and others who may be supposed to be, not only interested in the laboratory, but in a position to perform valuable service in connection with its administration.

A good deal of the work done in the laboratory is of no direct interest to us, but in the metrological division it is evident from the report, that a good many things have been done that are of direct interest to those who are concerned with problems of machine construction. Much work has been done during the year for the Engineering Standards Committee, whose work has been several times referred to in our columns. Some of this work is referred to in the report as follows: "With a view to the standardization of the different classes of fits of shafts and bearings, and the tolerances on interchangeable cylindrical parts of machines, it was deemed advisable by the Standards Sub-Committee to determine, as far as possible, the prevailing practice in English engineering workshops, and the accuracy of workmanship attained. A large number of firms co-operated and sent samples of their work to the laboratory, all of which were measured up early in the year. As only such pieces of machinery as could conveniently be sent to the laboratory were thus dealt with, the work was afterward extended, and Mr. Atwell visited the works of some 13 firms and obtained measurements on about 800 specimens of various diameters up to 12 inches. Each specimen was compared with one of a set of standard length gages which were taken to the works of each firm visited. In each case the size aimed at was known, and thus the error in workmanship—in the difference between the size aimed at and the actual size as measured—was determined.

The average error was found to vary considerably with different classes of work, while in the same class of work it was found as a rule to increase with increase of diameter.

The specimens measured were taken from various kinds of enginering work, which may be broadly classed under the following heads, the average error in workmanship being placed after each:

Class of Work.	Error in Workmanship.	
	Shafts.	Holes.
Large Machine Tools.	0.0025″	0.0033″
Small Tools	.0005	.0010
Locomotives	.0031	.0025
Gun Mountings	.0012	.0014
Marine Engines	.0018	.0028
Gas Engines	.0020	.0028
High Speed Engines and Dynamos	.0011	.0010
All specimens-average	0.0016″	0.0018″

Ground shafts were found to be on the whole more accurate than others which had been turned in the ordinary way, the average error in ground shafts being found to be 0.0011 inch, while the average in shafts not ground were found to be 0.0019 inch. The allowances made for the different classes of fits were also determined in some 250 cases, but the results of these have not as yet been published.

We have published an account of a screw-cutting lathe which is in this laboratory, and the report states that four screws cut on this lathe have been measured up during the year, the error in a length of 36 inches being found in no case to exceed 0.0003 inch.

It would seem from the report that the new alloy of nickel and steel which has been named invar is more seriously considered than in our own Bureau of Standards, as we note that among the new apparatus that has been installed in the laboratory there are three electrically heated ovens that have been constructed for the artificial ageing of invar. One of these is suitable for pendulum rods, another for coils of measuring tape, while the third was specially constructed for the laboratory 4-meter, H-form bar, and supplies of invar for making other things are spoken of, such as standards of 50, 20 and 10 meters, and 200, 100, 50 and 25 feet. There have also been obtained two 20-meter invar tapes for use in catenary, which came from M. Carpentier, of Paris.

What is known as the 4-meter comparator has been practically completed, and has been used for comparisons of line measures in air. An apparatus intended to be applied to it, by means of which measuring or comparing will be done in a water bath, in order to secure constant temperature, is yet to be completed. It is interesting to note that measurements have been made on the 4-meter, H-form bar from time to time to determine its stability, and it is now undergoing heat treatment for artificial ageing, which will be completed in January. The report states that the automatic comparator for end gages, constructed for the laboratory by the French Artillery Department through the courtesy of the French Government has recently been delivered, and will be erected in the measuring room. With it a set of 19 cylindrical gages and 117 end gages have been acquired, forming a very complete set in the metric system.

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Contents.

	PAGE
Testing Hacksaws	531
A Crooked Molding Machine Job	532
The Westinghouse-Finzi Alliance	536
List of Cone and Gear Ratios for Variable-Speed Drives	536
Some New England Shop Notes	538
A Comprehensive Time Card	540
Engineering Reminiscences	542
Systematic Economy in Making Drawings	546
Letters to the Editor: A Special Fixture for the Chucking Lathe....Holding Drawings Flat in their Drawers....Mandrel for Turning Boring Cutters....Aliining an Auger-Bit by its Shadow—Making a Rough Core-Box—The Design of Commercial Printing....A Slotter-Tool Holder for Large Work....A Finishing Tool....Metric Screw Threads....The Minimum Diameter of Wire Rope Sheaves....A Stop Clutch for the Power Press....System in the Drawing Office....Should a Machinist Sit While Working?....Bending Bolt Bodies....Operating Valve for an Air Hoist....A Locomotive Lifting Beam....Brazing Light Work....Safe Load on Chains	547-553
Some Notes on Motor Driving	554
Variable-Speed Gear Box	554
Some Recent Important Work of Scientists	556
Robert Fulton Memorial	557
The Chattanooga Meeting	557
Manufactures in Massachusetts	557
New Publications	557
New Tools and Machine Shop Appliances	558
Personal	561
Obituary	561

Some Recent Important Works of Scientists.

Science has been defined as classified knowledge, and scientists as those who systematically observe phenomena and classify the knowledge thus gained. We are reminded of these definitions by the article contributed to the *New York Times* by Prof. Ralph Stockman Tarr, of Cornell University, upon the subject of the recent earthquake in California, and in which article Professor Tarr does more to allay unnecessary fears of earthquakes and to point out the real dangers of them, than has been elsewhere published on the subject so far as it has come to our notice.

It is the fashion in certain circles to rather despise the scientist and he is sometimes compared to the "practical man", as though the scientists were not practical; an assumption which we think a perusal of Professor Tarr's article ought effectually to dispose of.

And in this connection we may mention an article which appeared in the April number of *Harper's Monthly* by another scientist, Prof. Robert K. Duncan, professor of chemistry in Washington and Jefferson College. In this article Professor Duncan tells of the work of a few other scientists, and the article shows clearly the facts and some of the methods by which certain scientific investigators have developed processes of manufacture which have averted otherwise certain famine, and probably the destruction of the human race. The article is of the utmost interest, and though at a glance it seems to relate entirely to agricultural products, it yet has a close connection with industrial matters as well.

In his introductory paragraph, Professor Duncan goes over familiar ground for the benefit of the layman and reminds us of the difference between free nitrogen, as it is found in the atmosphere and fixed nitrogen as we have it in fertilizing substances, perfumes, synthetic medicines, gunpowder, nitric acid, etc.

Free nitrogen is very abundant, but our supply of fixed nitrogen is being rapidly exhausted, Professor Duncan fixing the time of its practically complete exhaustion as about 20 years hence if present conditions continue. But the supply of free nitrogen is almost unlimited, there being in the atmosphere 33,880 tons of it upon every acre of the earth's surface.

Nature has methods of changing the free nitrogen into fixed nitrogen, but these processes are very slow—far too slow for the needs of the human family as now organized, and in view of the tremendous waste of nitrogen constantly going on; this waste being illustrated by the fact, for instance, that England alone "hurries down her water courses to the sea, nitrogen to the value of $80,000,000 a year."

The problem that the scientists have set for themselves then is, to devise an efficient and expeditious way of transforming free nitrogen into fixed nitrogen. This has been attacked by the aid of electricity; Cavendish having shown over a hundred years ago that this could be done, even with the tiny electric spark at his command, and our latter-day masters of electricity are able to do it upon a much larger scale. It is interesting to note in this connection that when this has been done by the burning of the air in an electric arc, "the only reason," according to Professor Duncan, "why this flame when once ignited has not spread through the surrounding atmosphere and deluged the world in a sea of nitric acid is the peculiar fact that its ignition point is above the temperature of its flame. It is not hot enough to set fire to the adjacent mixture."

A number of scientists, a few here in America, and a much greater number in Europe, have been working upon this problem, and a firm which has been a leader in the promotion of it is one well known to our readers, the Siemens & Halske Company of Berlin, who for years have employed the most able scientists in efforts to solve this great problem. Finally Prof. Adolph Frank, of Charlottenburg, while employed by them, discovered a method which has been successfully developed commercially, and as Professor Duncan says, "the world is now, thanks to Dr. Frank, in the possession of a fertilizing material that is almost ideal." This substance is calcium cyanamide, which under the name of "Kalkstickstoff" is now in the markets of the world.

It is curious to observe that in the manfacture of this material a very important and wholly unlooked-for use for liquid air has been discovered, for in its manufacture it is necessary to separate the atmospheric nitrogen from the atmospheric oxygen. They therefore first liquefy the atmosphere and separate the two substances by fractional distillation. The oxygen is then used for other purposes, but the nitrogen "passes suddenly from the intense cold of liquid air into the highest heat of the electric furnace, where, through contact with a mixture of coke and lime it is caught and transformed into Kalkstickstoff."

Not only is this material a very valuable fertilizer, and one upon which it seems we must soon depend for our very existence, but curiously enough a valuable use of cyanamide has been found, according to Professor Duncan, "in a curious function it has of causing the case-hardening of steel, and we find the great firm of Ludwig Loewe & Co., of Berlin, for one, continually using large quantities of it in the manufacture of tools and of arms for the Government."

Professor Duncan closes his article in the following insignificant paragraph:

"The present day practical lesson of this

whole strenuous successful work lies in the little object lesson it affords of the immense importance which technical science is assuming in our daily lives, and in all our industrial operations. The substitution of real knowledge and high technical skill for the rule-of-thumb of our ancestors has created a revolution in industry. This revolution took its rise in Germany, and is spreading rapidly to every corner. It is spreading silently, too, *because it does not pay to tell.* During the next five years the small manufacturer who is wiped out of existence will often wonder why. He will ascribe it to the economy of the large-scale operations, or business intrigues, or what not, never knowing that his disaster was due to the application of pure science that the trust organizations and large manufacturers are already beginning to appreciate."

Many of our most important industries are based upon the discoveries of scientists who themselves usually make little or no money out of them. Many of those who do make the money, in their ignorance, scoff at scientists as not being "practical men." The apparently most trifling fact correctly observed and recorded by a scientist may become the foundation of an industry of the utmost importance, and there are numerous instances where this has actually occurred.

Robert Fulton Memorial.

In connection with the proposed celebration of the centennial of the inauguration of steam navigation on the Hudson River, a movement is on foot to raise funds for the erection of a memorial to Robert Fulton. The movement was opened in a public sense by a lecture by Mark Twain at Carnegie Hall the evening of April 19, the proceeds of which are to go to the fund. This was announced as Mr. Clemens' farewell lecture and was delivered in his old-time and best manner. It was concluded with a touching appeal for relief for the smitten city of San Francisco where he lived for three or four years in the 60's as a reporter of *The Call.* The great hall was filled to its capacity.

The Chattanooga Meeting.

It is not often that an opportunity presents itself for combining so much of business and professional advantage with enjoyment as will be possible for members of the American Society of Mechanical Engineers at the Chattanooga meeting. Aside from the program of the meetings themselves, Chattanooga and vicinity is so rich in historical associations that no one interested in the gigantic struggle through which this country passed forty years ago ought to miss seeing this section, in which so much was done having an important influence upon the final outcome and upon the subsequent development of this country. Not only this but the region is one of extraordinary grandeur, and it will be seen at this time of year under especially advantageous conditions.

It is hoped that no one who can possibly get away will fail to attend the meeting, and it is certain that everyone who goes will have a thoroughly good time, aside from the other advantages usually resulting from such a meeting.

San Francisco.

We have many friends in San Francisco from whom at this writing we have not heard, and we can only hope that they have escaped the destruction which seems to have overtaken most of the city. San Francisco has had many previous earthquake shocks, and there was one just previous to the meeting of the American Society of Mechanical Engineers in that city in the spring of 1892, which, though it somewhat disturbed prospective visitors to the city at that time, was of no serious consequence. The present disturbance is, by far, the most serious that has ever been visited upon the city, and one cannot help wondering why men will choose to live in a location liable to be subjected to such catastrophes. The only answer must be that it possesses attractions thought to overbalance the chances of disaster, and we know of nothing which more strongly reflects the power of those attractions in the case of San Francisco.

Latest advices are to the effect that the city will be rebuilt at once and that the steel structures having stood the recent shock well, most of the new buildings will be of that material.

Manufactures in Massachusetts.

The preliminary manufacturing statistics for the last census covering the State of Massachusetts show that there has been a decrease in the total number of manufacturing plants established in the State from 10,929 in 1900 to 10,723 in 1905, but an increase in the amount of capital invested from $781,867,715 to $965,948,887, and the value of the products from all the establishments from $907,626,439 to $1,124,092,051 or of 23.8 per cent.

Turning our attention more particularly to the statistics covering, in the barest detail the work of the foundries and machine shops located in the State we find that there were 823 establishments in 1900 as against only 693 last year, but that the capital invested has increased from $61,022,495 to $72,622,672. The amalgamation of smaller establishments into larger ones, which has been steadily taking place, does not seem to have the effect that has been dreaded in some directions of lessening the number of employees, as we find that on the payrolls in 1900 there were 2093 salaried employees who received $2,785,384, whereas in 1905 the number had increased to 2632, and the salaries to $3,646,359; the average number of wage earners has increased from 32,104 to 32,972, and the wages paid from $17,772,854 to $19,271,924.

The miscellaneous expense shows an increase from $3,514,107 to $5,701,887, and the cost of materials used from $21,201,706 to $22,261,429; while the total value of the products of all these establishments has increased from $55,894,278 to $58,508,793.

From these preliminary figures it would seem that the industries covered are in a prosperous condition.

New Publications.

"Jahrbuch der Automobil-und Motorboot-Industrie." Prepared by order of the German Automobile Association by Ernest Neuberg, Civil Engineer. Third year. 554 7½x9½-inch pages, with 1120 ills. Boll und Pickardt, Berlin. Price, bound, 12 marks.

This is the third edition of an automobile annual in German which contains a great deal of technical and other material. About half of it is occupied with articles from various pens on constructive details and other topics. They include papers on: The condition of automobile technics at the international exhibition in Berlin in 1905; the development of the automobile industry; fuels; power; transmission; frames, axles, wheels and tires; internal combustion motors; electric vehicles; steam vehicles; results of prescribing the cost of acetylene lanterns, etc.; electric ignition; speed meters and signals; motor bicycles; motor boats; motor airships and flying machines. The object seems to be to give the progress in these lines since the last annual volume. Certain departments are treated for the first time. The one on machine tools does not appear this year. The latter half of the book contains digests of German, Austrian, English and American patents, an index to technical literature and articles on laws, taxation, etc.

Another new publication makes its appearance, devoted to the automobile industry, and which has for a name, *Motor Traffic.* It is devoted to the so-called "business automobile"—such automobiles as are used for trucking in cities, and for public service of various kinds. The new journal is attractively gotten up mechanically, has a number of interesting articles in its initial issue, and is to be published on the 15th of each month by E. E. Schwarzkopf, from the Times Building, New York City. Its editor is S. W. Merrihew. Its size is 9¼x12⅜, so that those who wish to file it may readily trim it to 9x12 inches, or standard size, which we think is what the publisher should make it.

New Tools and Machine Shop Appliances.

A SPUR-GEARED CHAIN HOIST.

The illustrations show a spur-geared chain hoist of high efficiency. The main wheel *Q* is mounted on a hollow shaft which projects through the cheek *E*. Rigidly mounted on the hollow shaft on the outside of the cheek *E* is the gear *B*. Through the hole in the center of the hollow shaft passes a small shaft *L* having at one end a small pinion *A* integral with it. This pinion *A* meshes with the two gears *D* and *C*, loosely mounted on studs

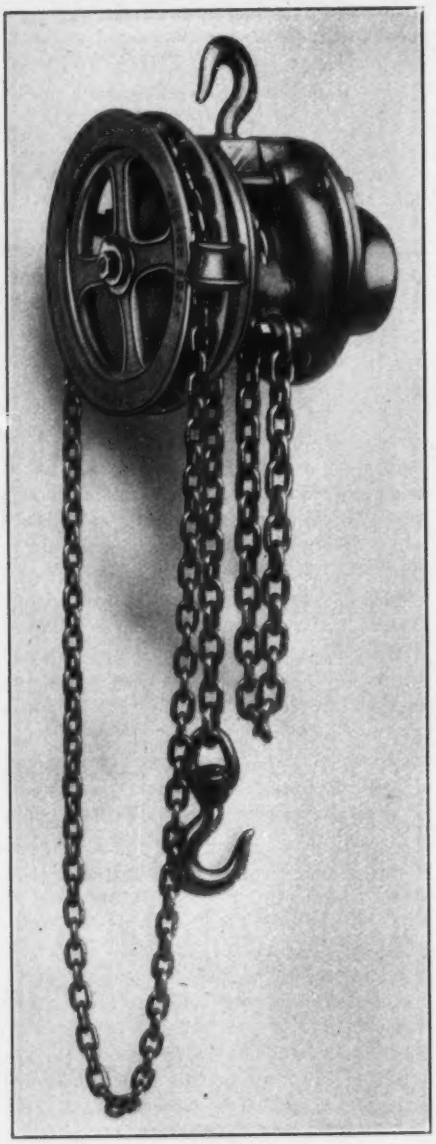


FIG. 1. A SPUR-GEARED CHAIN HOIST.

rigidly secured to the cheek *E*. Behind *D* and *C* and rigidly secured to them are two pinions which mesh with the gear *B* mounted on the hollow shaft upon which the main chain wheel is secured. The hollow shaft does not project beyond the outside of the cheek *F* but the shaft *L*, upon which is the pinion *A*, does. The line cut Fig. 5, shows a section of the hoist. *G* is a yoke pivoted at *H*, it carries a ratchet pinion *N* rotatable on the stud *I*. The yoke *G* is capable of a swinging movement controlled in one direction by a recess in the cover, and in the other direction by the pinion *N* coming into engagement with a pawl *P* secured to the cover. The cover with the recess and pawl are

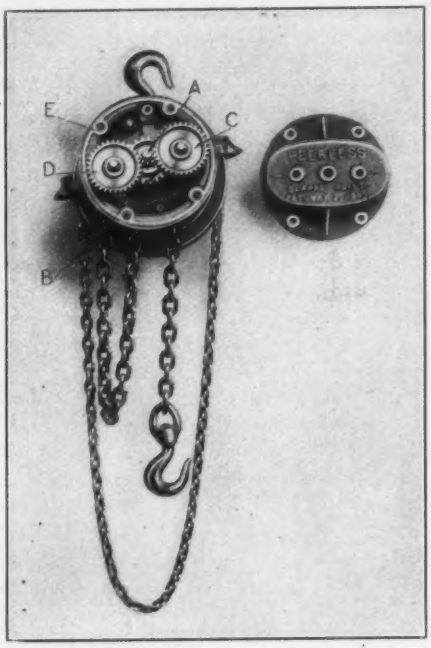


FIG. 2. THE GEAR END OF THE HOIST.

shown in Fig. 3. To the right of the yoke in Fig. 5 is a friction plate *M* made integral with a sleeve having a square thread screw cut on part of its exterior. This friction plate has a key *T* in it fitting a spline in the shaft *L* on which it is a sliding fit. A ratchet wheel *K* slips over the plain part of *M*, on which it is an easy fit. The ratchet wheel *K* is recessed to

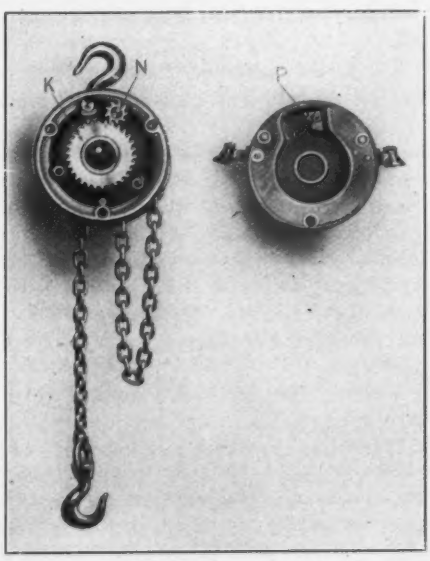


FIG. 3. THE FRICTION END OF THE HOIST.

receive the friction disk *M*. Between the surface of the friction disk *M* and that of the ratchet wheel *K* a piece of leather *R* is placed. The ratchet wheel *K* engages with the pinion *N*. The teeth of these two wheels are so formed that the driver, which is *K*, can only rotate in one direction. The moment the motion is reversed the teeth of the pinion *N* interfere with the teeth of the gear *K*. The yoke then swings from right to left, carrying the pinion *N* with it till the pinion engages the pawl *P*. The position of the pawl *P* is such that the flat part of the teeth of the gear *K* and pinion *N* take the strain.

The action of the hoist is as follows: The hand-chain wheel *S* threaded to fit the square thread on M is pulled in the direction necessary to hoist the load attached to the hook; this advances the wheel *S* on *M* toward the friction disk.. The load on the hook acting through the main chain wheel *Q*, the gear *B*, the gears and pinions *D* and *C*, the pinion *A*, the shaft *L* and the key *T* tends to keep the friction *M* from turning. The hand-chain wheel *S* therefore draws the friction plate *M* toward it, jamming the leather friction plate and the ratchet wheel *K* between the hub of *S* and the plate of *M* until the friction here becomes greater than that necessary to lift the

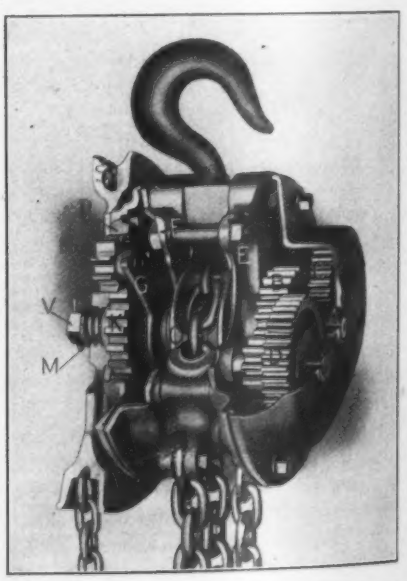


FIG. 4. A MUTILATED HOIST SHOWING THE MECHANISM.

load. When this occurs the shaft *L* rotates and with it the train of gears connecting it with the main chain wheel. The friction plate *M* turns and with it the ratchet gear *K* and the pinion *N*. However, the moment the pull on the hand chain ceases the action of the load reverses the direction of rotation of the gear *K*, the teeth of the pinion *N* interfere and the yoke is swung over to the left engaging the pinion *N* with the pawl *P*, sustaining the load. Pulling on the lowering side of the hand chain releases the strain between the friction plate and the gear *K*, allowing the friction to slip, but the load tends at all times to tighten the friction surfaces, so in order to lower any distance the lowering chain must be kept in mo-

tion. To prevent the hand-chain wheel *S* from being slackened off too much or jamming at the outer end, a washer *U* having a projection on it is put under the nut *V* on the end of the shaft *L*, the pin *W* in the hub of the hand wheel *S* comes in contact with this projection on the

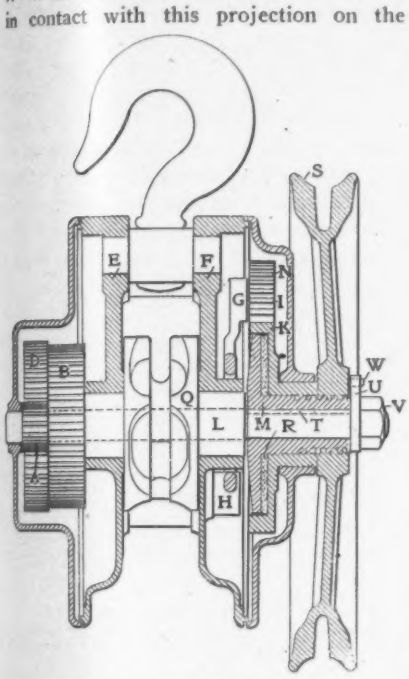


FIG. 5. SECTIONAL VIEWS.

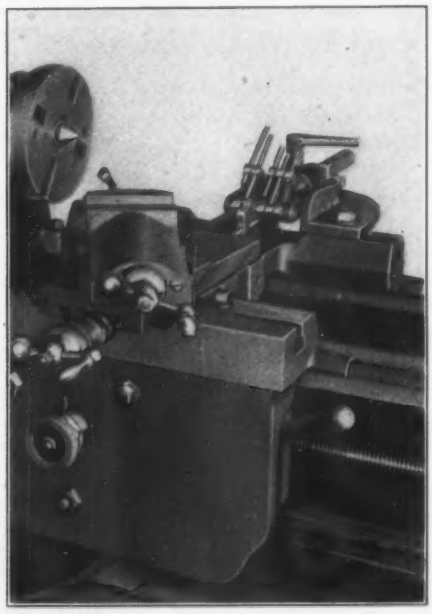
washer *U* when lowering. All of the gears are made of steel and have cut teeth. All shafts are of steel. The mechanism is protected by gray-iron covers, so that all dust and dirt are excluded. The chains are made of iron, and each link is tested separately by a special machine. These hoists have been named "Peerless" and range in size from 1000 to 40,000 lb. capacity. They are manufactured on the interchangeable plan. The limit of accuracy is considerably smaller than one usually expects to find in the manufacture of chain hoists, i. e., 0.002. The makers are Edwin Harrington, Son & Co., Philadelphia, Penn.

A SPECIAL MILLING MACHINE.

The illustration shows a special milling machine designed to handle straight line work 8 feet long by 12 inches wide and having one or more surfaces in line but on different planes. The machine is portable and originated in a temporary rig which the manufacturers were obliged to make in order to do work on a large machine in place. The idea was elaborated on from time to time until it reached the dignity of being a special tool. The bed of the machine is mounted on a sub-base having set-screws for adjustment. The sub-base has slots and projections for securing it to the work by means of clamps or bolts. The carriage has a travel of 8 feet with automatic feed, the cross feed of 12 inches is by hand, the vertical adjustment of the spindle is 10 inches. The end of the spindle has a taper hole for the reception of end mills. The drive of the machine being by motor, permits it to be taken to a job and used anywhere that current for it is obtainable. It is built by H. B. Underwood & Co., Philadelphia, Penn.

A MULTIPLE-STOP FOR THE CROSS SLIDE.

This device is intended for use when



A MULTIPLE STOP FOR THE CROSS SLIDE.

duplicating work having a number of different diameters on the same piece. It may be used in connection with the multiple-stop applied to the ways of the lathe, which we described and illustrated at pages 597 and 598, Vol. 25. This arrangement carries six stops, each independently adjustable. These are secured to a head which is attached to a bar working in a clamp, secured to the back of the carriage.

The approximate locating of the device is by means of the bar and clamp, the stops are then each located separately. Each stop as required is swung down to a horizontal position; the back of the cross-slide coming in contact with a stop determines the diameter of the work.

This device is manufactured by E. J. Bowers, 3029 Chestnut St., Philadelphia, Penn.

MULTIPLE TOOLS FOR BRASS WORK.

The half-tones illustrate some brass-working tools devised to perform two or more operations each, hence called by their maker "multiple" tools. The first

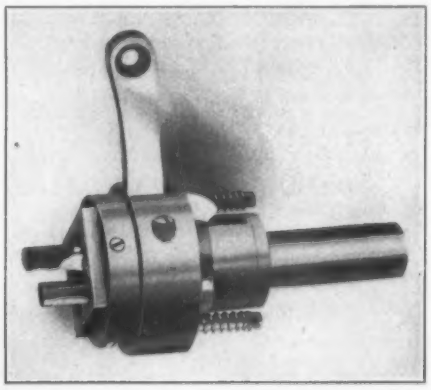


FIG. 1. TURNING AND THREADING TOOL.

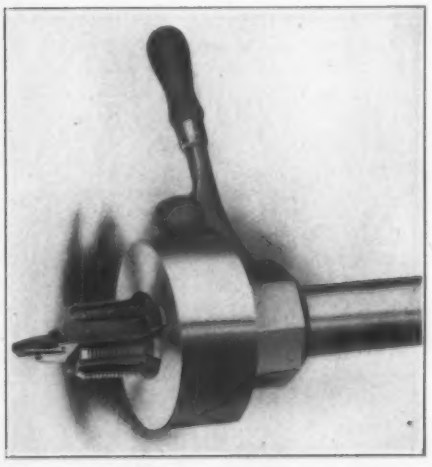
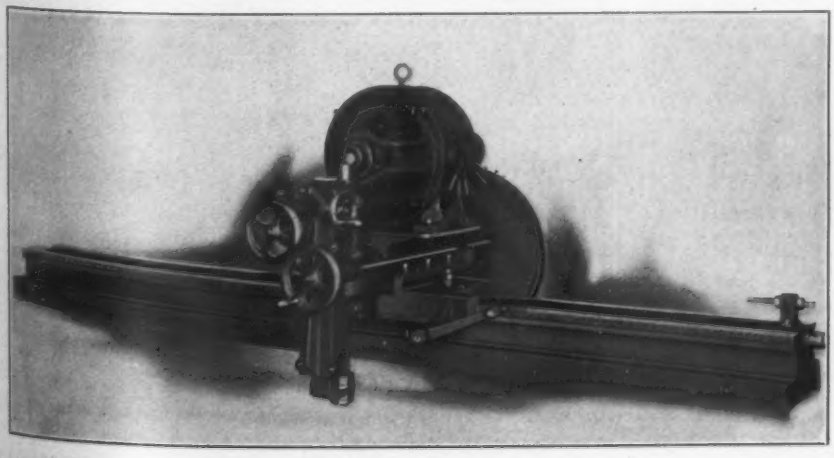


FIG. 2. COMBINATION TOOL FOR INTERNAL WORK.

of these, Fig. 1, is for turning the outside of a job, finishing the end and cutting the thread, and consists of a sliding die carrier, normally held back in its seat by a pair of turning and facing cutters which are secured in the body of the tool and project through the clearance openings in the die. When the tool is run on the piece, as soon as the cutters have performed their work the lever at the top is



A SPECIAL MILLING MACHINE.

pressed back and its lower end then forces the die ahead and onto the work. Upon reversing the spindle, the die as it runs off is drawn back to its original position by the springs at the back.

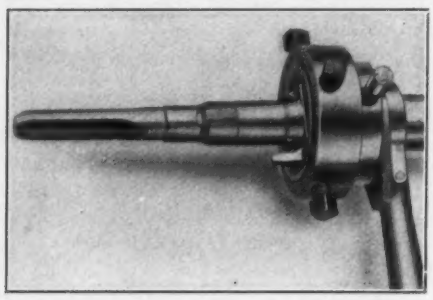


FIG. 3. TOOL FOR EXTERNAL AND INTERNAL WORK.

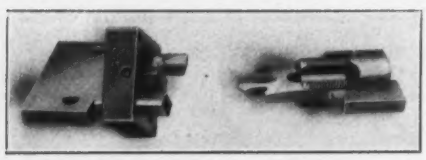


FIG. 4. SHOWING CONSTRUCTION OF TOOLS.

The tool in Fig. 2 is for internal operations, and is suitable for finishing out brass cocks, etc., forming the valve seats, and tapping the thread, as well as machining the outer end. In operation it is similar to the tool in Fig. 1, the lever being pressed to push the tap into action upon the completion of the work of the flat cutter. Fig. 3 is another combination tool constructed along the same lines. The tools used in the apparatus illustrated in Figs. 1 and 2 are shown in Fig. 4 withdrawn from their holders. The die in the left-hand view slides freely over the prongs of the flat cutter; and the tap to the right is milled along either side to admit the cutter which is slotted from the rear end well toward the front. The maker is the Julien D'Este Company, Boston, Mass.

"BRISTOL" PORTABLE RECORDING GAGES.

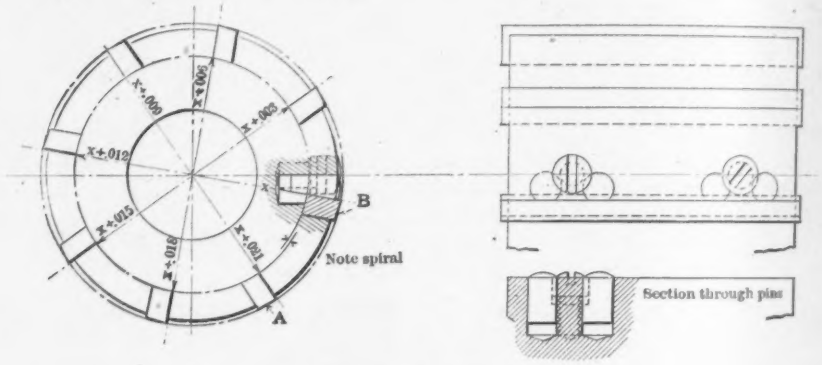
The use of recording pressure gages has become quite widespread, and many users having felt the need of a light, compact, portable recording pressure gage, the modified design illustrated has been placed upon the market.

In these portable gages the metal case has been omitted, the pressure tube and clock for driving the chart being mounted on a light aluminum back, which is in turn mounted in a handsome wooden carrying-case designed with special reference to ease in handling and making connections to the source of pressure.

For recording pressures which may exceed five pounds per square inch, the type of gage illustrated by Fig. 1 is employed. A special flexible connection with unions is supplied to facilitate connecting to piping at various angles. When a permanent installation is unnecessary, this instrument could be used to advantage, as, for example, on boiler tests, water mains or fire protective systems where a few accurate and continuous records would settle disputes or lead to better service.

For gas pressures in outlying districts, mine ventilating pressures, draft or light vacuum, the gage illustrated by Fig. 2 is adapted, since it is capable of recording pressures as low as one-twentieth inch head of water. Connection is readily made by means of a rubber hose to a nipple which projects through the side of case. A simple clamping device is employed to hold the pressure tube rigidly, when the gage is being transported.

Those who are interested in the distribution of gas will be particularly pleased to note the production of an instrument which will be of such great assistance in solving their problems. These portable gages weigh about one-third as much as the standard form gage mounted in a carrying-case, which has been used heretofore as a substitute. Both forms are furnished with leveling screws to facilitate adjustment of the instrument, and provision is made for carrying a supply of charts and ink with each gage. They are made by the Bristol Company, Waterbury, Conn.



ADJUSTABLE REAMER.

ADJUSTABLE REAMER.

The accompanying engraving illustrates an adjustable reamer, the blades of which are made interchangeable, the blade seats being arranged radially on a spiral, that is at evenly increasing distances from the center, so that by advancing the blades each one slot the reamer is expanded

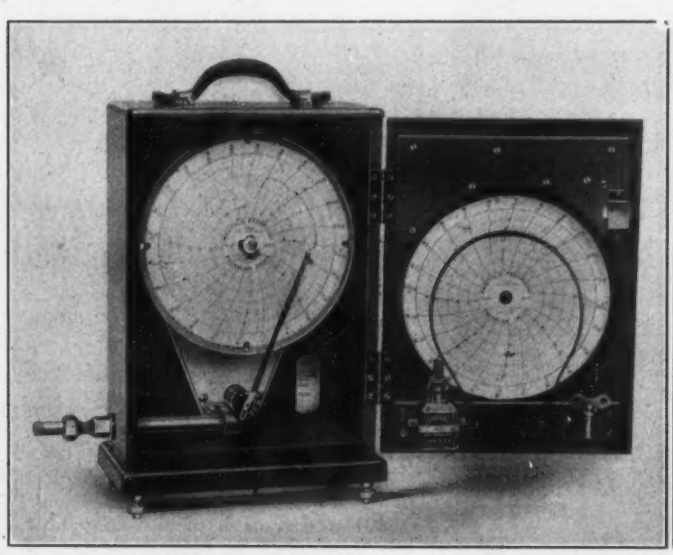


FIG. 1. BRISTOL PORTABLE RECORDING PRESSURE GAGE.

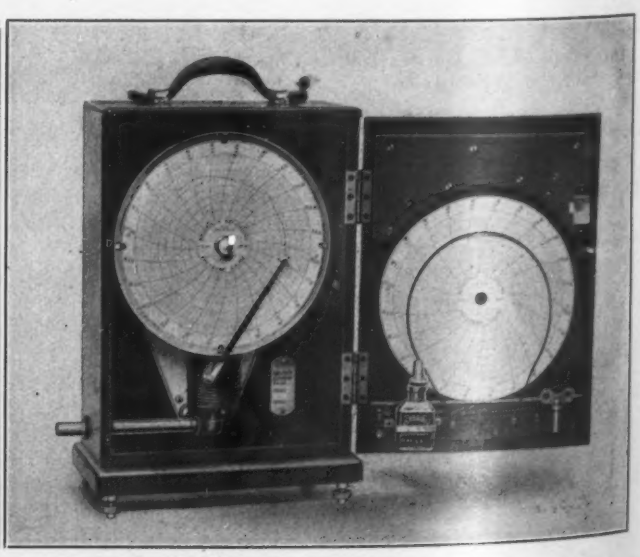


FIG. 2. BRISTOL GAGE FOR LOW PRESSURE OR FOR VACUUM.

concentrically. To re-size the reamer it is necessary only to discard the thinnest blade (shown at *A*), advance the others each one seat, insert a new standard blade in the vacant seat *B* and regrind to size. The expansion principle admits of the blades being inserted in dovetails or parallel grooves and fastened in any of the well known ways. The clamping device shown in the drawing provides two screws for each blade, each screw clamping the blade at two points. The sides of the clamping plugs are shown flatted at an angle so as to force the blade against the bottom and rear of the seat. This construction of course admits of a single plug being used if preferred. The blades are clamped metal to metal and thus held solidly throughout the life of the tool, and they are always in the same position endwise, permitting the reamer to be used in blind holes and close to the face plate of the chucking machine. It is obvious that after the first round each blade may be ground as many times as there are blades in the reamer, and also that the shifting of the blades expands them the right amount for grinding without guesswork in adjusting. The patentee of this reamer is Robert T. Johnston, Plainfield, N. J.

LARGE ADJUSTABLE WRENCHES.

The illustration shows the size to which monkey-wrenches have been developed.

A 6-FT. MAN WITH A 3 AND A 4-FT. WRENCH. The man is a six footer, he holds in his right hand a 48-inch, and in his left a 36-inch wrench. The larger wrench opens to 9½ inches.

These wrenches are made by the Coes Wrench Company, Worcester, Mass.

In connection with the convention of the American Foundrymen's Association and the Associated Foundry Foremen, to be held in Cleveland, Ohio, June 5, 6 and 7, an exhibit of foundry supplies and equipment is to be held in the Central Armory. The exhibit is to be arranged in a rectangle with a space for the convention in the center. Arrangements are being made to supply power for driving and it is expected that several of the Cleveland exhibits will be in operation. The entertainment features of the convention will probably include a lake excursion occupying one day, with two sessions on the boat; an excursion by touring cars through the park system, with one session at Case School; a visit to some of the local foundries; also an evening reception and either a smoker or a theater party. The hotel headquarters of the association will be at the Hollenden.

The address of the Engineers' Society of Western Pennsylvania has been changed and is now 803 Fulton Building, Pittsburg, Penn.

Personal.

Chas. E. Hyde has become connected with the newly organized New London Marine Iron Works, at New London, Conn., Mr. Hyde being president and general manager. Mr. Hyde's work at Bath, Maine, for some years past is well known and in the new enterprise he will have increased scope for his ability.

C. Frank Schwep has been appointed general purchasing agent of the Ingersoll-Rand Company with headquarters at 11 Broadway, New York. Mr. Schwep has been at the head of the purchasing department of the Ingersoll-Sergeant Drill Company, for the past thirteen years and was located at the shops at Easton, Penn., and Phillipsburg, N. J.

Hiram Cudworth, who for a number of years past has been general foreman with Prentiss Bros., has taken a position as travelling salesman and demonstrator for the Norton Grinding Company. Hans Wickstrom, who commenced with the above named company in the shop and has become a demonstrator, has taken up work as a salesman also, the two men representing the company in that capacity.

Obituary.

William D. Zehnder, president of the Scranton Bolt and Nut Works, of Scranton, Penn., died recently at that place. He was formerly engaged in the iron and steel industry in Reading, Danville and Lebanon.

Professor Curie, the discoverer of radium, was run over and killed by a wagon in Paris, April 19. He was born in Paris in 1859. At the time of his death he was a professor to the faculty of sciences at the University of Sorbonne.

George W. Stockley, of Cleveland, Ohio, one of the pioneers in the electrical business in this country, and the first president of the Brush Electric Light Company, died at Atlantic City, April 19. His death was due to pneumonia. Mr. Stockley was born in Cleveland fifty-three years ago.

Manufacturers.

The Williamsburg (Iowa) Canning Company will build a plant.

The Burden Iron Company, Troy, N. Y., will erect a new rolling mill.

The Superior Foundry Company, Cleveland, Ohio, will build an addition.

The Allum Brass Foundry Company, Cleveland, Ohio, will erect a factory.

A $13,000 machine shop will be erected for Friedenwald Bros., Baltimore, Md.

The National Iron Works, Duluth, Minn., will erect an addition to its plant.

The Colorado Canning Company, Canon City, Colo., is erecting a new building.

The Merrimack Iron Foundry, Lawrence, Mass., has plans out for a new foundry.

Plans have been completed (for a plant) for the Aermotor Company, Chicago, Ill.

The Acme Shear Company, Bridgeport, Conn., will build an addition to its factory.

The Birmingham Iron Foundry, Derby, Conn., is having plans drawn for a new building.

The New York Belting and Packing Company will build additions to its Passaic, N. J., plant.

J. S. McMaster & Company, Rutland, Vt., will erect a factory for the manufacture of excelsior

The Manhattan Rubber Company will erect a $17,000 addition to its plant, in Passaic, N. J.

The White Enamel Refrigerator Company, St. Paul, Minn., will build a $10,000 addition to its plant.

The Kansas City (Kan.) Cotton Mills Company has been granted a charter and will erect a plant.

The Odin Stove Manufacturing Company, Erie, Penn., is having plans prepared for a new foundry.

The Lowell Steam Plow Manufacturing Company, Kansas City, Mo., is looking for a site for a plant.

The Hutchinson (Kan.) Interurban Railway Company has bought a site for a power house and car barns.

The Eastern States Refrigerating Company, Jersey City, N. J., will add a new building to its plant.

The Standard Welding Company, Cleveland, Ohio, has obtained a permit for the erection of a factory.

Sears, Roebuck & Company, Chicago, Ill., will erect a factory in Rockford for the manufacture of furniture.

The American Dressed Beef and Provision Company, Kansas City, Mo., is erecting a new $10,000 ice plant.

The Swift Packing Company, Kansas City, Kan., has taken out a building permit for a new $15,000 ice plant.

The A. F Tyler Company, Athol, Mass., will build an addition for the manufacture of doors, sash and blinds.

The Milwaukee (Wis.) Electric Railway and Light Company will put up a new power house in Racine, it is said.

A new factory building and foundry will be erected for the R. G. Denyes Machine and Tool Company, Grayslake, Ill.

Plans and specifications are being prepared for a municipal water plant at Baton Rouge, La., to cost about $100,000.

The Jackson (Mich.) Fence Company, manufacturers of machines for building wire fences, will erect a new plant.

Fred A. Havens & Company, contractors, Philadelphia, Pa., have plans for a machine shop to be built in Scranton, Pa.

Plans have been completed for the enlargement of the municipal lighting plant at South Brooklyn, Cleveland, Ohio.

An addition will be built to the plant of the Spangler Mfg. Company, York, Pa., makers of agricultural implements.

The Roos Mfg. Company, Chicago, Ill., which makes window poles, fancy furniture, etc., will build a new $60,000 plant.

The E. A. Wagner Mfg. Company, sheet metal stamping, etc., North Milwaukee, Wis., will build an addition to its factory.

The Homer (La.) town council has granted a franchise to Ed. Sawyer of Ruston, La., to install an electric lighting system.

F. P. Pfleghar & Sons, New Haven, Conn., manufacturing general hardware and sheet-metal goods, will erect a new factory.

The A. Geisel Manufacturing Company, St. Louis, Mo., will erect a plant for the manufacture of stamped and enameled ware.

The Simon Packing Company has been organized at Youngstown, Ohio. Capital, $100,000. Judge J. C. Ewing, president.

C. J. Matthews, Philadelphia, Penn., will build a five-story addition to his leather-manufacturing plant at a cost of $30,000.

Fire damaged the metal works and drop-forging factory of Crandall Stone Company, Binghamton, N. Y., to an extent of $10,000.

The Keystone Leather Company, East Camden, N. J., will erect a factory in Bristol, Pa., to be used as a japanning department.

The Baltimore & Ohio Railroad has filed plans for terminal improvements in Philadelphia, including new shops to cost $750,000.

Fire destroyed the plant of the George W. Pitkin Paint Manufacturing Company, Chicago, Ill., causing a loss of almost $100,000.

The Stanley Works, manufacturing builders' hardware, etc., New Britain, Conn, will build a six-story factory and enlarge the present one.

The Southern Railway Company has awarded the contract for the erection of a new, large machine shop at the Lonsdale, Tenn., plant.

The Lake City Ice Company, Cleveland, Ohio, a new concern, capitalized at $50,000, has contracted for the construction of a plant.

A new factory building and power house will be erected for the Wuest-Bowman-Hunt Company, manufacturers of candy, Cleveland, Ohio.

A new brass foundry and machine shop will be erected at the plant of William Highton & Sons, Nashua, N. H., manufacturers of hot-air registers.

The Willard Bag and Manufacturing Company, Wilmington, N. C., will construct a new plant to replace the one which was burned some time ago.

The E. Keeler Company, Williamsport, Pa., boiler manufacturers, will erect a new plant at a cost of nearly $150,000 to be used in connection with the present one.

The Morse Twist Drill and Machine Company, New Bedford, Mass., has practically completed arrangements for the purchase of some land on which to extend its plant.

The Mora Motor Car Company has been incorporated with a capital of $150,000, and will locate in Newark, N. Y. William H. Birkell, of Newark, is one of the directors.

The Speakman Supply and Pipe Company, Wilmington, Del., has bought a building which will be converted into a foundry for manufacturing brass fittings and plumbers' supplies.

The W. W. Carre Company, Ltd., Hagan avenue, near Tulane avenue, New Orleans, La., is in the market for a second-hand Corliss engine, cylinder about 30 inches diameter.

The Wagner Electric Manufacturing Company, St. Louis, Mo., will erect a new plant. Dodge & Day, Phiadelphia, will prepare the layout, design buildings and select the equipment.

It is said that the Tennessee Coal, Iron and Railroad Company, Birmingham, Ala., and elsewhere, will erect a new $2,000,000 steel mill, and that $15,000,000 will be spent in enlargements.

The Babcock Tissue Paper Company has been incorporated at Otsego, Mich., with a capital of $50,000. Bruce Babcock, president. A plant comprising three buildings will be erected.

An independent weaving mill, to be known as the Taber Mill, is to be established in New Bedford, Mass. The capital stock is $350,000. Frederic Taber is president of the board of directors.

Fire partially destroyed the bolt and rivet plant of the Falls Rivet and Machine Company, Cuyahoga Falls, Ohio, the power transmission machinery plant not being affected in any way.

The Fuller Combing Gin Company, Charlotte, N. C., is n the market for complete equipment for wood shops, machine shops and foundry. The plant will be electrically lighted and driven.

Fire destroyed one of the buildings at the plant of the Whitlock Coil Pipe Company at Elmwood, Conn., causing a loss of about $35,000. This, however, will not affect operations at the plant.

The D. T. Williams Valve Company, Cincinnati, Ohio, will put up a new plant to cost about $158,000, one of the features of which will be a brass foundry for the manufacture of automobile trimmings.

W. E. Thomas & Company, Berkley, Va., operating a marine railway, are erecting an addition to their plant, which will be equipped with planers, resaws, bandsaws, etc., for building and rebuilding boats.

The National Ice Company has been organized with a capital of $1,500,000 at Philadelphia, Pa. The new concern which will put up five plants has taken offices in the Mutual Life Building, Philadelphia.

The H. A. Adams Tool Company of Hartford, Conn., is being incorporated with a capital of $100,000. Harry A Adams, formerly superintendent of the Fox Typewriter Company, of Grand Rapids, Mich., is president.

The Stirling Boiler Company, of Barberton, Ohio, which recently consolidated with the Aultman-Taylor Works at Mansfield and the Babcock and Wilcox Works, of Bayonne, N. J., will spend $600,000 in improvements.

The Springfield (Mo.) Manufacturing Company has been incorporated to make pins, brackets and cross-arms for telephone and telegraph purposes, bed springs, mattresses, etc. T. R. Whitlock will be general manager.

The William A Kavanaugh Company, of Zelienople, Pa., and elsewhere, will move all its plants to Norwalk, Ohio, where the combined plant will manufacture a full line of gas and steam engines, oil and gas-well tools.

The New England Steel and Copper Plate Company has been incorporated at New Britain, Conn. Capital $20,000. Incorporators, W. W. Penfield, LeRoy W. Penfield, New Britain; Thomas E. Elliott, New Haven.

A company is being organized at Johnstown, Penn., to establish a large forge plant, which will make a specialty of steel car forgings and automobile parts. John H. Waters, of the National Radiator Company, is one of the incorporators.

The M. E. Smith Company, Omaha, Nebr., makers of overalls and shirts, is erecting a factory and warehouse which will contain a laundry, printing plant and paper-box departments. There will also be 1000 sewing machines to be run by individual motors.

Catalogs.

The Burke Machinery Company, Cleveland, O. Circular illustrating and describing coal oil forge.

Pratt Institute, Brooklyn, N. Y. Pratt Institute Record, 1904-1905, containing report of the secretary.

Coes Wrench Co., Worcester, Mass. 1906 Catalog of Coes "Genuine" screw wrenches. Illustrated, 6x9, paper.

Omega Steel and Tool Co., Ansonia, Conn. Catalog of high speed steel and tools. Illustrated, 5x7½, pp. 24, paper.

Westinghouse Electric & Mfg. Co., Pittsburg, Pa. Circular No. 1128, illustrating and describing small power motors.

University of Cincinnati, Cincinnati, O. Announcement of the Technical School containing calendar for 1906-1907.

Hart-Parr Co. Charles City, Iowa. Catalog of gasolene engines, traction, portable, stationary. Illustrated, 6x9, pp. 36, paper.

The Metropolitan Engineering Co., Brooklyn, New York. Catalog No. 101, describing electric signs. Illustrated, 6x9, pp. 32, paper.

Pick Electric Co., Yonkers, N. Y. Circular illustrating and describing electro-magnetic friction clutches and Lilliput clutch controller.

Newton Machine Tool Works, Philadelphia, Pa. Catalog No. 43 describing cold saw cutting off machines. Illustrated, 6x9, pp. 29, paper.

Electric Machinery Company, Minneapolis, Minn. Bulletin No. 21, containing price list of engine type spherical generators, also dimension sheet.

E. G. Smith Co., Columbia, Pa. Circular explaining clubbing proposition this company is making for the sale of its calipers, levels and other tools.

National Brake & Clutch Co., 16 State St., Boston, Mass. Catalog of "Compo" pulley and clutch, with cork inserts. Illustrated, 6x9, pp. 21, paper.

Mossberg Wrench Co., Central Falls, R. I. Catalog of "Sim-Pull" counter-shafts and "Multi-Pull" belt shifters. Illustrated, 4½x6, pp. 16, paper.

Massachusetts Institute of Technology, Boston, Mass. Bulletin of summer courses for 1906 and circular giving dates of entrance examinations for 1906.

Dean Bros. Steam Pump Works, Indianapolis, Ind. Circular No. 54, describing Atlantic type boiler feeders or pressure pumps. Illustrated, 6x7, pp. 16.

Purdue University, Lafayette, Ind. Catalog containing a register of the students during 1905-1906, lists of the faculty and announcements for 1906-1907.

Hardinge Bros., 1034-1036 Lincoln Ave., Chicago, Ill. Supplement to 1901 catalog describing the new Cataract bench lathe. Illustrated, 6x9, pp. 14, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, N. Y.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—An 18" x 8'-0" engine lathe. Must be in excellent condition. Give name of maker and lowest price. N. C. W., 486, AM. MACH.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford st., Philadelphia, Pa.

Work Wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Mechanical Draftsman—Large contracting firm desires man experienced on lay-out of steam-power plants; permanent. G 5617, Engineering Agency, Inc., Chicago.

Mechanical Draftsman—To do designing on cement-mill machinery; state experience and salary expected; permanent. G 5530, Engineering Agency, Inc., Chicago.

Wanted—A 20" planer with at least 4'-0" stroke. Must be in first-class condition and a modern tool. Give all particulars and lowest price. N. C. W., 485, AMERICAN MACHINIST.

Manufacturers of iron and wood-working machinery, machine shop and foundry equipment and supplies are requested to send catalogs to the New London Marine Iron Works, New London, Conn.

Shop Organizer—Little defects in tools, product and shop organization consume profits. For a moderate outlay I will visit your factory and reduce your manufacturing cost to the minimum. Thirty years' experience. C. E. Tower, 1237 Monadnock, Chicago.

Tool catalog No. 22, 950 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

Wanted—English concern wants high-grade specialty man who understands every detail of manufacture of milling cutters, gauges, and templates, the marketing of product and management of selling force. No one considered who has not been actively engaged in line indicated. Salary $5000 to $10,000. Hapgoods, Suite 508, 309 Broadway, New York City.

Wanted—Experienced inspector on small interchangeable work. Must be practical mechanic who can handle men tactfully and insist on work being turned out accurately. Prefer man with previous experience on small firearms, typewriters, computing scales or similar lines. Will have entire charge of inspection department. Location near Philadelphia. Salary $1300. Address, Hapgoods, 1105 Penna. Building, Philadelphia, Pa.

For Sale.

For Sale—Foundry, Wood & Iron machine shops, Albion, N. Y. Box 74.

For Sale—One Fellows gear shaper; good as new. Box 496, AMERICAN MACHINIST.

For Sale—10-h.p. Knox gasoline engine for automobile or stationary purposes. Price, $75.00. Box 1171, Springfield, Mass.

For Sale—Bound volumes AMERICAN MACHINIST, 1880-1900 inclusive. Splendid condition. Box 419, AMERICAN MACHINIST.

For Sale—Controlling interest in foundry and machine shop in thriving city of middle West. Only foundry in neighborhood; minority partners are practical foundrymen and willing to retain interest. Owner has business elsewhere requiring attention. $5000 in cash required. Address Box 162, Mt. Carmel, Ill.

Business Opportunities.

Wanted—A growing machine tool shop desires capable mechanical man who can invest in same. Good, legitimate opportunity. Address Manager, 408 AMERICAN MACHINIST.

Half interest for $4250 can be had in old machinery and automobile repairing business. Highest standing. Annual net earnings $6000. Want good machinist or automobile expert. Box 488, AMERICAN MACHINIST.

Wanted—To arrange with a machine shop having a reasonably modern equipment for manufacture of machine tools. Would lease or arrange on contract basis. Must have 48" planer, 60" horizontal boring mill, turret lathes, grinders, etc. Reply, giving location and general information. Strictly confidential. Box 491, AMERICAN MACHINIST.

Wanted—High-grade engineering salesman to manage a department for well-known machinery houses in New York. Fine opportunity and attractive salary for man of exceptional ability who can show results. Must be thoroughly familiar with territory and be in position to invest from $2000 to $5000. In writing, give full details as to previous record and present salary and position. Address "Engineer," 434, AMERICAN MACHINIST.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Position as foreman of machine room; references. Foreman, 493, AM. MACH.

Wanted—Position as master mechanic by first-class mechanic; first-class references. Mechanic, 492, AMERICAN MACHINIST.

An up-to-date mechanical superintendent of small factory, building light high-speed machinery, and in good standing with present employers, desires to locate with a more progressive concern where development and systematic production are required. Address Box 490, AMERICAN MACHINIST.

ILLINOIS.

Machinery salesman, experienced, would like line on commission. Send catalogs. Box 465, AMERICAN MACHINIST.

Mechanical engineer with extensive experience in equipment of progressive manufacturing plants and in designing special machinery and tools. Box 474, AMER. MACH.

IOWA.

Chief draftsman; a mechanical engineer, at present chief draftsman with a large manufacturing concern in the West. Box 269, AMERICAN MACHINIST.

NEW YORK.

Position as draftsman—Some experience, 2 years in shop; salary moderate. Box 479, AMERICAN MACHINIST.

Mechanical draftsman, 25, technical education, four years' experience, wants to change. Box 495, AMERICAN MACHINIST.

Works manager or superintendent, located near New York City, will be open for position by June 1st. Box 461, AMER. MACH.

Superintendent, practical, energetic, systematic and fully reliable, with best references, seeks position. Box 497, AM. MACH.

Chief draftsman, specialist on automatic machinery; broad general experience; practical mechanic; technical. Box 494, AM. M.

Practical mechanic, designer and good inventor, 30, desires position as designer or machine-shop foreman. Box 480, AM. MACH.

Assistant Sales Manager—Can handle machinery quotations with customers or makers; college, shop and long office experience. Box 489, AMERICAN MACHINIST.

General foreman (36), responsible man, practical mechanic, successful in producing first-class work at satisfactory cost, varied experience, desires change. Box 482, AM. M.

Designing draftsman, M. E., age 30, two years' shop, 9 years' office, on special machinery, tools, fixtures, devices. Inventive, practical, good judgment, hustler. Box 484, AMERICAN MACHINIST.

Patternmaker, 30 years' experience on light and heavy work (5 years present foundry) desires steady position owing to foundry removal. Patternmaker, 550 E. 140th St., New York City.

Position as superintendent or general foreman in plant manufacturing steam, marine, gas or gasolene engines; general mill machinery; fine grade automatic machinery; Box 462, AMERICAN MACHINIST.

Position as superintendent by young mechanic of proven executive ability, wide experience in handling work and men on gas and steam engines and electric machinery. Alive to results accomplished by good systems and can apply same. Good organizer of departments and designer of special tools. Box 481, AMERICAN MACHINIST.

PENNSYLVANIA.

Competent designer, experienced in the construction of heavy tools and hydraulic machinery wishes responsible position. A-1 references upon application. Box 464, AM. M.

WISCONSIN.

A machine shop foreman wishes a change. Address Box 473, AMERICAN MACHINIST.

Help Wanted.

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CANADA.

Wanted—First-class machine-shop foreman. State experience fully. The Smart-Turner Machine Co., Limited, Hamilton, Can.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Wanted—A good, capable, energetic man to take charge of machine and manufacturing shop in Connecticut. Address Lake, 407, AMERICAN MACHINIST.

Coremaker foreman for large foundry in New England. Good salary to man capable of handling 75 coremakers on high-grade work. Give full particulars as to age, experience, references, salary desired and class of work most familiar with. Box 410, AM. MACHINIST.

GEORGIA.

Wanted—A superintendent for a plant employing 500 men, manufacturing steam engines, saw mills, and wood working machinery. Must have a thorough technical education, as well as a practical knowledge of the business, including the foundry and modern moulding machine practice. Address M. M., 466, AMERICAN MACHINIST.

ILLINOIS.

Wanted—Jobbing foundry and machine shop desires correspondence with responsible man as manager and solicitor. City of 10,000, 100 miles from St. Louis. Box 435, AM. M.

Wanted—Man of business experience and recognized standing as engine expert to take charge of gas-engine development for large manufacturing company. Box 403, AM. M.

Wanted—General foreman for large shop making special machines. Only high-class, practical, experienced man of executive ability, who is holding similar position, will be considered. Requires man fully capable of handling 300 to 400 men. State if experienced in foundry work. Excellent opportunity. All communications held strictly confidential. Box 421, AMERICAN MACHINIST.

IOWA.

Manager for old established plant, manufacturing engines and mining machinery. Must have up-to-date methods and thorough mechanical knowledge along with business ability to take full charge of plant. Fine opportunity for the right man at good salary. Please give age and general experience in first letter. A. B. C., 463, AMER. MACH.

MASSACHUSETTS.

Expert gear-cutting man; also one young man for general office and shop assistant. Boston Gear Works, Boston, Mass.

Wanted—Draftsmen; two reliable and experienced men on web printing presses and kindred machinery; applicants must state age, experience and terms. Box 453, AM. M.

Wanted—Two mechanical draftsmen, men with some experience in structural steel work or steam boiler construction preferred. Location near Boston. Box 404, AM. MACHINIST.

Wanted—A shop superintendent for an electrical manufacturing plant in New England. Pay roll of 200 names, and rapidly

growing business. Detail knowledge of electrical manufacturing is not essential, but of course desirable. A permanent position for a good man. Box 476, AMERICAN MACH.

Wanted—Man (preferably 35 to 40 years of age) thoroughly competent to take charge of inspection in modern shop, manufacturing complicated automatic machinery. Wide experience in connection with the interchangeable production of small parts, made to very close limits of accuracy, is essential. State age, salary, and give references. No applicant will be accepted without careful investigation of previous record. Box 433, AM. MACHINIST.

MICHIGAN.

Wanted—First-class machinist to act as instructor in gasoline engine factory, machine dept. Must be a hustler. State age, experience and wages. Box 468, AMER. MACH.

MINNESOTA.

Wanted—A competent foreman for a general machine shop in the Northwest, employing about 200 men. Must be capable of taking entire charge of plant and show results. To such a man we are willing to pay a good salary. Address, with full particulars, D. I. W., Box 454, AMERICAN MACHINIST.

Wanted—First-class machinists moulders and pattern-makers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel & Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical draftsman, preferably with experience of textile machinery. State age, experience, and wages required. The Clark Thread Co., Newark, N. J.

Wanted—First-class lathe and vise men for small steel work. Steady work, good pay, no trouble. Twenty-five miles from New York City. Box 194, AMERICAN MACHINIST.

Wanted—A first-class mechanical draftsman on electrical machinery; state salary expected and when ready to work; wanted by a factory in New Jersey, 20 minutes from New York. Box 447, AMERICAN MACH.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—Foreman accustomed to production of light interchangeable work, must also be good toolmaker, fully conversant with light experimental work, and accustomed to handling help. Address Box 429, AM. M.

NEW YORK.

Mechanical draftsmen wanted for Power House work. Edison Co., 360 Pearl St., Brooklyn.

First-class machinist wanted on automobile experimental work. Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Clerks familiar with premium cost systems. Address with reference, Box 475, AMERICAN MACHINIST.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Mechanical draftsman, young man with technical training and some practical knowledge of construction. Location New York city. State experience and salary. Box 472, AMERICAN MACHINIST.

Wanted—Chief draftsman of wide experience on web printing presses. Excellent opportunity. State age, experience, and salary desired. All communications held strictly confidential. Box 476, AMERICAN MACH.

Wanted—Competent correspondence and order clerk by large manufacturer of firearms; must have had good experience in this line; give experience in detail, references, age and salary expected. Box 450, AMER. MACH.

Wanted — Factory store-keeper; must be energetic and familiar with all supplies and materials used in the manufacture of firearms. Give detailed experience, age, references and salary expected. Box 449, AM. M.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hours work day; time and a half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

Wanted—First-class toolmakers accustomed to jigs and fixtures. Also two or three first-class diemakers accustomed to combination punches and dies. Location of works at Yonkers, N. Y. Steady work and good pay for first-class men. Apply by letter to Box 483, AMERICAN MACHINIST.

Wanted—A superintendent to take charge of instrument factory employing about 100 men. Must be experienced manager of men and thoroughly familiar with modern tools and automatic machinery, and capable of designing jigs, fixtures, etc., for getting out work. Box 487, AMERICAN MACHINIST.

Metallurgist Wanted—With practical experience in selection and testing of iron and steel for use in manufacturing of small machine parts; must be familiar with best practice in heat treatment and able to draw specifications securing best machining qualities consistent with given physical properties. A technical graduate capable of making accurate chemical analysis preferred. Thorough knowledge of tool steels desirable. Box 467, AMERICAN MACHINIST.

NORTH CAROLINA.

Wanted—Toolmaker thoroughly acquainted with modern mechanical methods; also with some experience in die making and gig work. Young man with technical knowledge preferred. Applicants give in detail past experience, present employment and remuneration required. Permanent position to the right man. Box 478, AMERICAN MACHINIST.

OHIO.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 455, AMERICAN MACHINIST.

Wanted—Foreman to take charge of 20 men making jigs and small tools. One who has had similar position. Address The Cincinnati Milling Machine Co., Cincinnati, Ohio.

Wanted—First-class man to take charge of designing of up-to-date jigs and fixtures for machine-tool work. Must be capable of giving instructions in use of the same. None but parties having practical shop experience need apply. State experience and salary wanted. Address Cincinnati Milling Machine Co., Cincinnati, O.

PENNSYLVANIA.

Wanted—Good toolmakers and machinists, familiar with Government work. Box 451, AMERICAN MACHINIST.

Wanted—Draftsman and engineer on hoisting engines and air compressors. Box 448, AMERICAN MACHINIST.

Wanted—Several first-class scrapers, also planer and lathe hands, for machine tool work. Address Colburn Machine Tool Company, Franklin, Pa.

Wanted—Machinery agent to sell hand and electric cranes in the following territory: New York, Pittsburg and Chicago. Box 477, AMERICAN MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections, these qualifications carry most weight; character, common sense, experience with automatic machinery, (or) printing-office experience, or type foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Penn.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

VERMONT.

Wanted—Draftsman with some experience on textile machinery preferred. State age, experience and pay. Box 470, AMER. MACH.

VIRGINIA.

Wanted at once, good draftsman on power plant and blast furnace work. Would get some outside work if competent to do it. Technical graduate preferred. Salary $100 per month for good man. Address "Longdale", 469, AMERICAN MACHINIST.

WISCONSIN.

As the result of doubling its new West Allis Plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Wanted—An experienced toolmaker and jig maker, capable of designing jigs for engine work. Give age, experience, reference and salary expected. Address Box 443, AM. M.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidental. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—Three first-class Gisholt turret operators; also twelve machinists. Weber Gas and Gasoline Engine Co., Kansas City, Mo.

Wanted — Thoroughly up-to-date foundry foreman; also first-class pattern maker; state salary, experience; also references; write Box 430, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	103
Acme Machinery Co.	34
Adams Co.	9
Albro-Clem Elevator Co.	105
Alliance Machine Co.	94
Allington & Curtis Mfg. Co.	26
Almond Mfg. Co., T. R.	107
Alteneder & Sons, Theo.	34
American Gas Furnace Co.	14
American Pulley Co.	110
American Tool Works Co.	8
American Tool & Machine Co.	100
American Tube & Stamping Co.	101
Armstrong Bros. Tool Co.,	92 and 103
Auburn Ball Bearing Co.	91
Aurora Tool Works.	98
Automatic Machine Co.	102
Baker Bros.	103
Baird Machinery Co.	85
Baldwin Chain and Mfg. Co.	89
Baldwin Steel Co.	81
Barker & Co., Wm.	86
Barnes Co., B. F.	24
Barnes Co., W. F. & John.	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E.	96
Bay State Stamping Co.	96
Bay State Tap & Die Co.	104
Bay State Tool Co.	26
Beaman & Smith Co.	15 and 106
Becker-Brainard Milling Machine Co.	23
Bertram & Sons Co., John.	92
Besly & Co., Chas. H.	109
Bethlehem Fdry. & Mach. Co.	91
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	93
Bilgram, Hugo.	34
Billings & Spencer Co.	91
Binsse Mach. Co.	34
Birdsboro Steel Fdry & Mach. Co.	73
Blaisdell Machinery Co.	98
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	108
Boker & Co., Hermann.	79
Boston Gear Works.	104
Boynton & Plummer.	26
Bowers, E. J.	26
Bradford Machine Tool Co.	5
Bridgeport Safety Emery Wheel Co.	102
Bristol Co.	4th cover
Brown-Cochran Co.	96
Brown & Co., R. H.	106
Brown Hoisting Machine Co.	95
Brown & Sharpe Manufacturing Co.	4th cover and 69
Buffalo Forge Co.	4th cover
Builders Iron Fdry.	3d cover
Bullard Auto. Wrench Co.	90
Bullard Machine Tool Co.	32
Bury Compressor Co.	98
Butler, A. G.	98
Calculagraph Co.	28
Caldwell & Son Co., H. W.	105
Carborundum Co.	20
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	92
Case Mfg. Co.	95
C & C Electric Co.	24
Chambersburg Eng. Co.	90
Champion Tool Works.	108
Chattanooga Machinery Co.	93
Chicago Rawhide Mfg. Co.	104
Chisholm & Moore Mfg. Co.	94
Cincinnati Electrical Tool Co.	91
Cincinnati Machine Tool Co.	20
Cincinnati Mill. Mach. Co.	6 & 7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	110
Clark Cast Steel Cement Co.	97
Clark, Jr., & Co., Jas.	93
Cleveland Automatic Mach. Co	18
Cleveland Crane & Car Co.	94
Cleveland Stone Co.	90
Cleveland Twist Drill Co.,	4th cover
Cleveland Wire Spring Co.	22
Clough, R. M.	85 and 90
Coates Clipper Mfg. Co.	86
Coes Wrench Co.	33
Colburn Machine Tool Co.	22
Columbus Machine Co.	96
Cook Co., Asa S.	89
Crescent Forgings Co.	99
Cresson Co., Geo. V.	107
Crocker-Wheeler Co.	27
Crosby Steam Gage & Valve Co.	17
Crowe Name Plate & Engraving Co.	97
Cumberland Steel Co.	85
Curtis & Co. Mfg. Co.	94
Curtis & Curtis Co.	100
Cushman Chuck Co.	106
Davis, Rodney.	105
Davis Machine Co., W. P.	84
Desmond-Stephan Mfg. Co.	102
Detrick & Harvey Mach. Co.	83
Diamond Machine Co.	3d cover
Diehl Mfg. Co.	26
Dill Machine Works, T. C.,	28 and 84
Dixon Crucible Co., Joseph.	97
Dodge & Day.	93

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Roll Grinding.

BY C. H. NORTON.

It is the popular belief that rolls are practically perfect in that they are round and concentric with their axes, and if you seek the reason for this popular faith in the accuracy of rolls, you will find that it is because they are ground while rotating upon their own journals. So fixed has this belief become that 99 out of every 100 mechanics will tell you that the fact that a roll is ground while running upon its own journals is proof sufficient that it is perfect. Further investigation will show that few have given any thought as to the effect of the inaccuracy of the center holes on which the journals, or necks, were turned, or have even known whether these journals or necks were round or in line with each other. Still further inquiry will show that few roll makers or users take into consideration the error caused by the imperfections of the lathe spindles on which the necks are turned, or the eccentricity of the center point in the rotating spindle. Careful tests with a

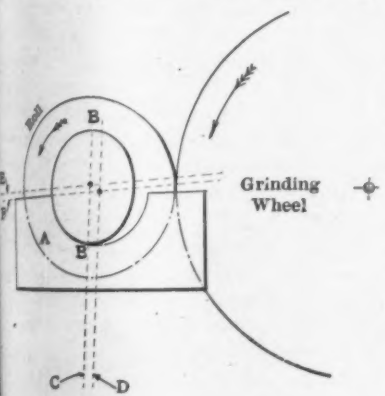


FIG. 1. ROLL GRINDING.

good indicator, reading to thousandths, would probably show nearly every roll lathe to have a spindle bearing not round and a center point not true. An examination of the center holes in rolls will, I think, show that very few are true; yet mechanics, while ignoring these facts, are content to rest their faith in the accuracy of a roll solely because it rotates on the journals while being ground.

All mechanics who grind really accurate work in the line of toolmaking, machine-building, etc., are accustomed to grind such work on two dead centers, and they know very well that they cannot obtain perfect work unless they do so; but roll makers have reasoned differently. It seems strange that accuracy can be obtained in one case by a certain method and not in the other. With this thought in view, I some time ago took up the matter of grinding rolls, with a view to ascertaining the facts. After considerable investigation the following facts were discovered:

1. If the necks or journals are perfectly round over their entire length and if the two necks are perfectly in line with each other, then the grinding of the roll when rotating on these necks will give perfection, not otherwise.

2. Not a single roll examined had necks that were round or in line.

3. Not one roll examined had round center holes on which to produce round journals or necks.

4. When the center holes were scraped to remove the imperfections, then the necks could be made round *only by grinding them while rotating on these perfected holes and on two dead centers which were also ground perfectly round.*

5. When the center holes were round enough to grind the necks perfect when rotating on perfect center points, the body of the roll could be ground perfectly round and concentric with the necks while rotating on the same centers at the same time.

6. A grinding machine rigid enough to grind perfect necks on centers is also rigid enough to grind perfect bodies on centers.

But, I am told, surely there must be some reason for this time-honored tradition. It cannot be that everybody is mistaken. What can be the reason?

Let us hark back over some 50 years of machine making and if we listen carefully we can, no doubt, learn the reason for this practice when making rolls.

OLD TIME METHOD OF CENTERING AND TURNING ROLL NECKS.

The first roll necks, like all other cylindrical work, were turned literally on points. That is, there was a heavy center-punch mark made in the work with a blow from a sledge. This made it necessary that the center point of the lathe should be blunt (about 90 degrees), with the extreme point rounded. The bearing upon the center and in the hole in the work was obtained by wearing the two together under great pressure, and this method can still be seen in use both in this country and in Europe. I can remember seeing this method when a very small boy and when recently I saw a lathe man in one of our large American works centering and turning this way, I waited until he had finished the piece and learned that his method was identical with that I saw used by very old men when I was a lad. Have you seen it? Perhaps many who read the AMERICAN MACHINIST have not.

The workman grips the piece in the vise, places a center punch near the center, by his eye, and strikes it a light blow, then puts it on the centers of the lathe and rotates it by hand, chalking the high side. Then he again puts it in the vise and punches again, forcing the hole a little to that side, and again tries it on the centers. This time it runs a little better and he puts on a lathe dog and drives it by power while he forces the footstock center very hard, then a little harder and harder until he has forced a contact between the center point and the work. He then removes the work from the center and places the lathe dog on the other end and repeats the operation until he is satisfied that he has a bearing. Then he removes the pressure a little, squirts a little oil on the center and a lot on the floor, spits considerable tobacco juice on the lathe, and is ready to proceed with the turning. As he proceeds the case becomes more and more interesting. He has rough turned to the shoulder and now turns it about and rough turns the opposite end. Then he discovers that the central or shoulder part runs out. He calipers it and finds that there is not enough stock to true up with the finish cut, so he gets a bar and bends the work until it runs better. Then he is in doubt as to whether the part he has just turned will "clean up" so he springs it back a little and proceeds to "finish cut." When he turns the work about and is finishing the

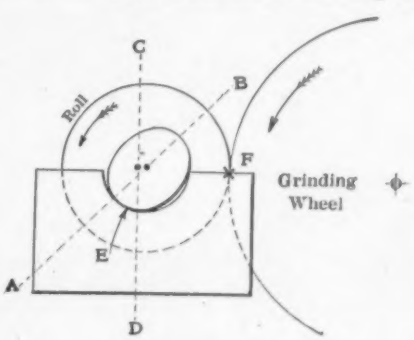


FIG. 2. ROLL GRINDING.

other end he seems to be in trouble about "cleaning up." He calipers several times, first with a light touch, then lighter and lighter as he tries to turn it clean and still satisfy himself about the size. When it is turned he holds his thumb nail against it in several places to note its errors, and after giving it another spring or two with the bar he files it hastily and rubs it with emery cloth.

This picture is true in every detail. I saw it recently in a large American works. In this case the lathe had 90-degree centers with the extreme points rounded.

It is, of course, impossible to transfer such work to another lathe and turn or grind true work, because there can be no uniformity of bearing on different center points. For this reason it was impossible to obtain true roll bodies by grinding on centers.

IMPORTANCE OF PROPER CENTERS.

Small depressions and blunt angles made certain that the axis of rotation would change during the grinding. This is still the condition, owing to the fact that few, if any, rolls have a center hole which is true, or of the correct angle, or of size sufficient to maintain a con-

stant axis of rotation. We in America call ourselves progressive. Many Americans are, but not all. We shall come to understand that there is but one way to obtain round work, whether it be rolls or machine spindles, and that is, to provide first a round center hole of an angle and size that will insure a constant axis of rotation, then the lathe spindle on which the work is rotated must also be round, and if we would have two roll necks in line, the spindle center must run true; not tested with the thumb nail, but with a well made, and not a cheap indicator. When we understand these facts we can grind rolls on centers.

The old center punched hole was improved by drilling a hole to clear the point of the center, but still the 90-degree angle was retained. Later someone discovered that if a well reamed center of 60 degrees was made in the work and the mouth of the angle was made large enough, the necessary strength of center could be obtained for the heaviest work and still use 60 degrees, an angle that would retain the same axis of rotation for a long time and allow the work to be transferred to other lathes having centers of the same angle. The prejudice against large center holes has been so great, however, that many concerns having heavy work still retain the 90-degree angle, or some other angle more obtuse than 60 degrees in order to prevent the breaking of center points when using small center holes. Makers of rolls were among this number, so that today we find rolls with centers of from 75 to 90 degrees and so small that the axis of rotation is in constant danger of changing while grinding.

There is still remaining in the minds of mechanics the idea that the center holes in work are but temporary and that little care need be taken to prepare them. This is evidenced by the total lack of facilities for making them round and their reckless exposure to damage in the works. The universal condition of center holes in rolls shows that not all roll makers and users regard them of importance. It is this disregard of the importance of correct center holes that makes it necessary for rolls to be ground while running on their own journals or necks; but grinding on their own necks does not necessarily give perfect results, while grinding on correct center holes must always give perfect results, if a good grinding machine is used.

When we consider that there has been no correct method used for making round center holes in rolls, we can understand why roll makers should avoid them. Today, if you ask a machinist to re-center a roll, he will place one of the old, worn-out necks on a center rest of a lathe and rotate it on this neck while, with great care, he will turn the center hole at the angle; and when you ask him if the center hole is round he will say, "Of course it is. I run it on the bearings and turned it true." You then ask him if the bearing is round and he will reply, "Of course it is. It was turned on centers." If you then ask him to ascertain if the center hole is really round, he will start up the lathe and again bring the tool against the angle of the hole and ask you to look and see that it runs true; and when you tell him that is no proof that it is round, he will either look at you in astonishment or set you down as a crank. But when you have explained that nothing but rubbing a really round center point in the hole with a little color on the surface can prove whether it is or is not round, he will sometimes ask you where he is to obtain that *really round* center point, but oftener he will take the center from his lathe that was simply turned in the spindle which may or may not have been round.

ERRORS DUE TO JOURNALS THAT ARE NOT ROUND.

Very few really know whether the lathe bearing is or is not round. A roll grinder complained that a certain grinding machine would not grind the rolls round on centers. Investigation showed that the centers were turned out while rotating the rolls in a center rest on the old, worn-out bearings, the grinder expecting then to grind the bearings round on those centers; a proposition about as sensible as the proposal to lift one's self over the fence by pulling on one's own boot straps.

"But," I am asked, "don't you see that whatever error there may be in the necks, if you run the roll on the necks and grind it, it is bound to be true because, if not round, the surface of the roll will be exactly the same as the neck, and therefore will run true?"

Well, that seems correct reasoning before you know better, but when one takes pains to demonstrate it by the aid of a perfect grinding machine and fine indicators and measuring tools he learns something different.

It is presumed that all understand that roll perfection means that when two rolls are turning together in the housings of the rolling mill the surfaces of the two roll bodies will remain a constant distance apart during the entire rotation, when under pressure. Now it is clear that the pressure of the work is against that part of the roll surface that is on the opposite side of the axis from the surface of the neck that is pressing against the box of the housings. It is also clear that when grinding, the grinding wheel is cutting at right angles to the resting point on the journal or neck.

The sketches Figs. 1 and 2 will show some of the things that occur when grinding a roll which rotates on journals that are not round. Referring to Fig. 1, the journal is shown oblong in shape in order to illustrate what may happen. The bearing *A* may be a perfect half circle of a diameter equal to the largest diameter of the journal *B*. As the roll turns in the direction of the arrow and the grinding wheel is pressing against the roll body, the axis will assume the position shown; that is, one side of the center of the bearing, or at *C*. When the roll is rotated ¼ of a turn its axis will have moved toward the grinding wheel at *D*. It will also have dropped from *E* to *F*.

The raising and lowering of the axis of rotation causes a variation of distance from the cutting face of the wheel to the bearing point of the journal.

Referring to Fig. 2 when the line across the greatest diameter, *A B*, is in the position shown, the axis is moving to the left toward *C D*, the position it will assume when the roll has made a part of a rotation. While this movement of the axis to the left is going on, the journal is rolling on the part of the box marked *E*, and for an instant is not really turning on its axis. This causes a high place where the wheel cuts during that movement.

When this roll is put to work in its housings, if the boxes of the housings are of the same size as the box used to grind in, this same motion will occur, but when the axis moves to the left and the journal rolls on the part *E* the work being rolled will not be at *F* where the grinding wheel has cut the roll, but rather at *C*. Now when the high place on the roll at *F* (caused by this movement of the axis to the left while grinding) shall have reached *C*, or the point where the work is done, the distance from the working face of the roll and the supporting surface of the journal will be greater than at *C*; therefore there will be greater pressure on the work, causing a thin place.

OTHER INACCURACIES CAUSED BY GRINDING ON IMPERFECT JOURNALS.

There are other combinations that would cause error due to journals being out of round, but this one is enough to show us that we cannot expect perfect work with rolls ground on imperfect journals. Perhaps the greatest errors are caused by the fact that the boxes in the housings will never bear in exactly the same places on the journals as the boxes in which the roll was ground, for of course if we grind on journals we do so when these journals are worn in ridges with high and low places to match in the boxes of the housings. Now let us suppose that the rings that are deepest are worn out of round the most. When the journal is running in the grinding machine box we get a bearing on the high rings only. It is easy to tell what will happen when the roll is put to work.

Suppose the journals are not in line. (This we know is often the case because we can see the boxes of the housings rocking as the rolls turn under pressure.) The bearing of the grinding machine in which the journals rotate in practice is seldom as long as the box in the housings and I have sometimes seen rolls ground

on what was little wider than an ordinary center rest. We see people grinding rolls on journals that are not in line and that have been in service a long time, using as bearings in the grinder very short boxes that support the journal about midway of its length. Now the fact that these journals are not in line causes the ends of each journal to run eccentric while the center, where it bears on the short box, will remain more nearly constant than the ends. A roll ground under these conditions cannot run true when rotating in a longer box.

GRINDING ON DEAD CENTERS.

There are many things to cause error when grinding on journals, while if large and round center holes be carefully made at first with the ends recessed to protect them, and the angle be 60 degrees with carefully ground center points on which to rotate, the journals can first be made round and in line by grinding on two dead centers and the roll body can also be ground concentric and round on the same dead centers.

The error from truth caused by wear of the journals during service must always be ground out when the rolls are reground, or accuracy cannot be expected. It is a fallacy to suppose that journals once round will remain so indefinitely. It is also a mistaken idea that the correcting of journals ground on good centers will reduce them sufficiently to vitiate their action in the bearings after they are replaced in the housings.

But the best proof that rolls can be successfully ground on centers is the fact that they are so ground, and that they are ground with accuracy that cannot be longer disputed. But the most interesting feature about the recent developments in roll grinding is the fact that they are ground at less expense than formerly. One concern grinds rolls of about 12 to 14 inches diameter at the rate of five per hour. One run of 360 hours produced 1800 ground rolls. These are used for rolling steel hoops.

Another concern making finely finished, bright steel work, uses 10-inch rolls. These must have a finely finished surface, and must run perfect, as the product must measure accurately with a micrometer. They grind and finish four per hour.

Both of these concerns are grinding their rolls on well made 60 degree centers.

A solder for aluminum has been invented, says Consul Atwell, of Roubaix, by Fernand Hecht, of that city. With a soldering iron he can join aluminum together or join aluminum to copper, brass, or iron. The invention is simple, no acids or salts being used. Mr. Hecht exhibited his process satisfactorily before the professors of chemistry of the Faculty of Science, and was awarded a medal.

A Large Cylinder-Boring Machine.

Two of the largest cylinder-boring machines ever built were recently constructed at the Niles shops of the Niles-Bement-Pond Company. These machines are for boring cylinders for blowers and the boring bar in each case is 30 inches in diameter. Fig 1 gives an excellent idea of the size of one of these tools. The facing heads, as will be noticed, are made double and are provided with the usual star feeds. They will face work up to 10 feet in diameter. The boring bar is provided with two boring heads, one for boring small work, the other for the largest cylinders.

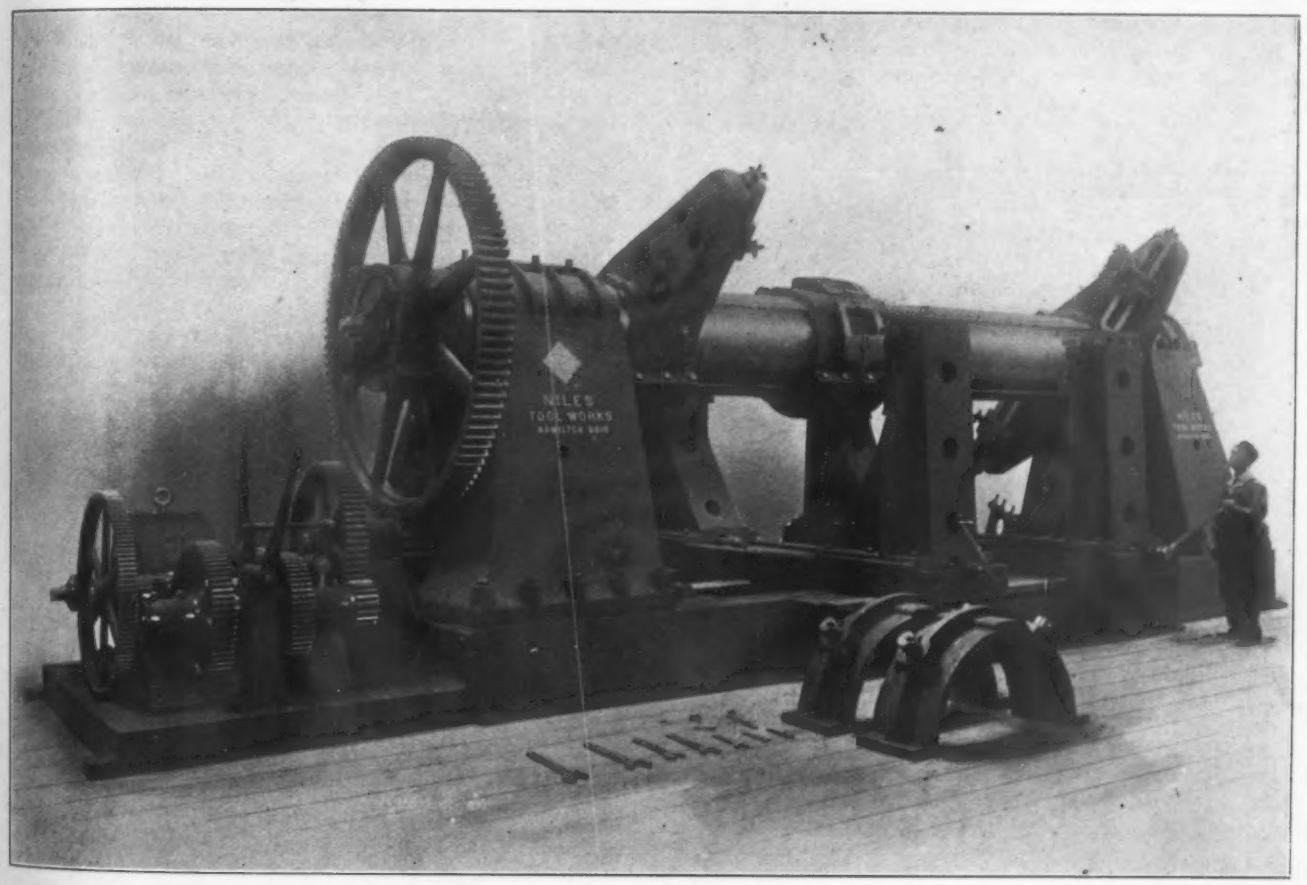


FIG. 1. LARGE CYLINDER-BORING MACHINE.

The smallest cylinder the machine will bore is 45 inches in diameter, the largest 100 inches. The boring bar has a wide range of speeds varying from 0.76 to 4 turns per minute, suitable for various diameters of cylinders and material of varying degrees of hardness. It is driven by a 25 horse-power motor. There are five changes of feed, the mechanism for obtaining which is shown in Fig. 2. The carriages are provided with special devices for supporting large cylinders. The distance from the center of the boring bar to the carriages is 5 feet, and from the center of the bar to the bed 5 feet 8 inches. The total length of the machine is 37 feet.

A patent has been granted for making pens of tantalum or alloys of it.

Piece Work.

BY J. BERTRAM.

A number of articles have been published of late on piece work, advocating different plans based on some form of percentage accounting, the writers evidently having in mind work that would require a number of hours to finish. While these articles are helpful they give very little assistance to one wishing to start piece work where it is not a matter of hours to finish a piece but seconds.

In this article I will take up a piece-work plan in which the price is fixed per piece, believing that whenever possible this should be done, as it appeals more directly to the operator than any other plan, for the operators as a rule are not mathematicians, and cannot work out examples in percentage.

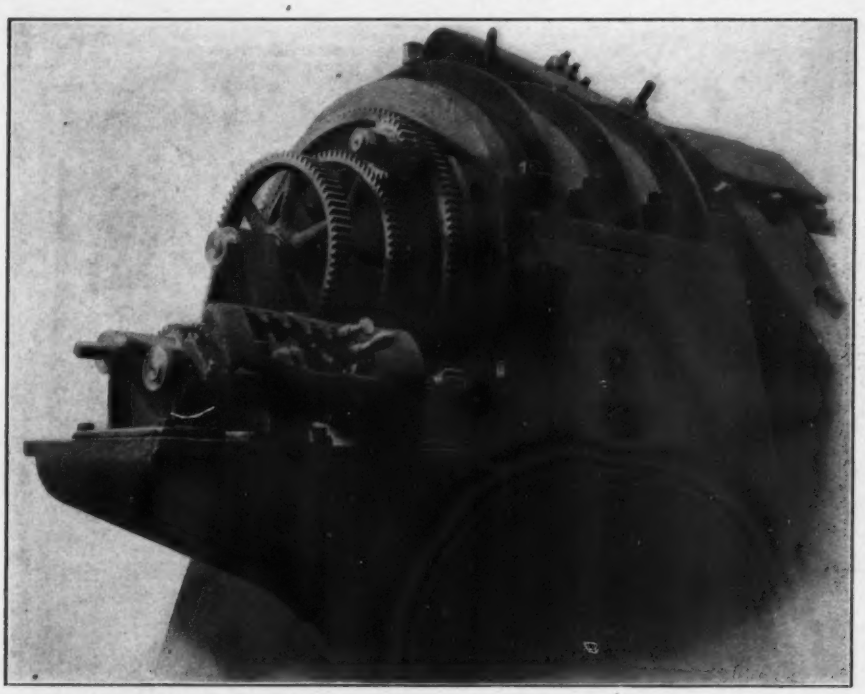


FIG. 2. BORING-MACHINE FEED GEAR.

To get the best results from this plan it is necessary:

1st. To positively guarantee that the price will not be cut.

2nd. To have the price right.

3rd. To pay promptly and correctly.

4th. To see that the work is done as well as when done by day work.

Operators have, for so many years, been used to having piece-work prices cut as soon as their earnings reached about 50 per cent. over their day-work rate, that they consider it one of the fundamental laws of manufacturing and as sure to follow large earnings as a discharge is to follow the breaking of the rules. This being the case, it is absolutely necessary to lean to the other extreme and not lower a price unless there has been a decided change either in the amount of work to be done on a piece, or in the tool to do it with. If the tools are changed the saving must be self-evident to the operator before the price is changed. When a price is established for doing an operation, if another job is started having exactly the same operation, the price must be made as for the first job.

To have the price right it cannot be based on a previous performance, especially if the work has been done by piece work on a price subject to cutting, nor left to the ordinary foreman, as not more than one in ten can be trusted to do it right, but it should be in the hands of a man specially fitted for the task. He must know when a piece of work is being done with the least number of motions, and when an operator is working as hard as he can and at a pace which he can keep up all day, as well as the proper day-work rate for each class of work. He must be trusted by the operators and be looked up to by the foreman. A price should never be made except on actual timing, that is the man making the price should see the work done in the time on which the price is based.

More feeling against piece work has been caused by poor clerical work than by any other one thing except cutting the price. When an operator has made an extra effort to increase his earnings and knows he has earned a certain amount, he wants every cent of it, and always feels that the employer is trying to do him if he does not get it the first pay day. The error may be corrected ever so promptly, but the first impression lasts. The counting must be done by a man whom the operators are sure will count correctly; otherwise they will waste enough time counting themselves to seriously interfere with their profits. The counting should be done by an accurate accountant, so as to bring the errors to a minimum. The saving of a few dollars on salary is often very expensive.

While the tendency of piece work is to lower the quality of work, properly handled it is actually the surest and best way to improve it. To make sure of an improvement the operator must understand that the work will not be accepted or paid for unless it is perfect, and there must be an inspector who will see that the operator does over again, at his own expense, all imperfect work. As a rule an operator will not send to such an inspector more than one lot that is imperfect. The inspector must not pick at trifles nor send back work that the operator knows is as good as work that is accepted when done by day work.

What is the right price? This question is constantly coming up, and the answer depends upon the results expected. I make a price per piece by multiplying the hourly rate that the operation is worth by the number of seconds that it takes to perform the operation and divide the product by 2500. For example, take an operation that is worth 20 cents per hour; set an ordinaary operator to perform it, time him when he is making no false motions and working as fast as he can be expected to do. If it takes him 250 seconds then the price would be

$$\frac{0.20 \times 250}{2500} = \$0.02$$

It will be found on using such a price a new hand will not make his day-work rate, but that an ordinary operator can make 25 per cent. over his day rate, and an expert at that particular operation will make from 50 to 100 per cent. over his day rate. A price giving that result is right, for if it is any lower it will be found impossible to get an operator interested in starting, and if it is higher the operator will hold back, for, make the assurance of no cutting ever so strong the operator will not believe it, as he will be afraid of a cut.

These being the facts an employer, to get the best results, must encourage the operator making large wages to make still more, for that will:

Bring up the output of the same shop to the highest point possible.

Increase the profits.

Decrease the amount of defective work.

Decrease the number of accidents both to operators and tools.

It is a well known fact that one operator will follow the lead of another and increase his output, when it would be impossible to get him to do it in any other way. If results are carefully watched it will be found that an operator earning 50 per cent. over his day-work rate is worth four that are only making 10 per cent., for a new operator will not make an extra effort if he thinks he cannot make more than 10 per cent. extra, but if he sees it is possible to make 50

per cent. extra he will do it if he has any ambition.

The expense of running a plant is a certain amount per operator, therefore as an operator increases his output the expense per price decreases and the profits increase. When a new or inefficient operator is doing the work, even on piece work, the increased expense per piece soon runs away with the profits.

It will always be found that the defective work does not come from the operator earning the highest per cent. of increase, but from the ones that are earning the lowest, for, in order to make high percentages, an operator has to be interested in his work and do the same operation so often that it becomes more natural to do the work right than wrong. An interested operator soon finds that the work can be done fastest by always doing it the same way.

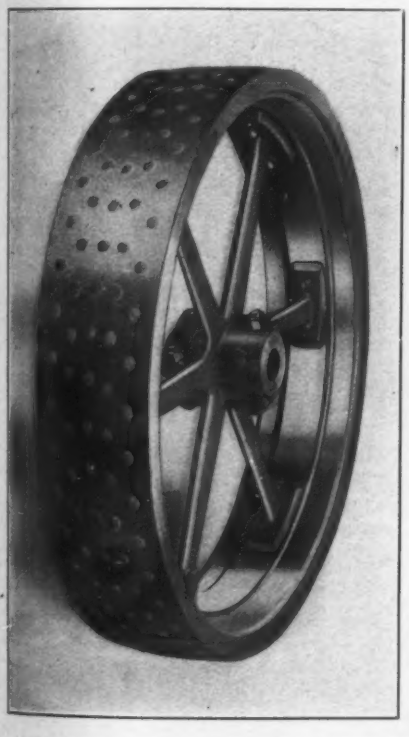


FIG. 1. PULLEY WITH CORK INSERTS.

For these same reasons the accidents decrease, for the accident that can be justly laid to a defective tool is rare. In most cases, when the real cause is found, accidents are due either to pure mischief or "rough housing." An operator interested in increasing his pay has no time for either.

When the items of expense, ruined work and broken tools are taken into consideration the employer's profits increase at a greater percentage than the operator's, even when the operator is making 50 per cent. over his day rate.

The world's production of pig-iron for 1905 was 53,540,841 tons, to which the United States contributed 22,992,380 tons, Germany, the next on the list produced only 10,813,983 tons, and England 9,592,737 tons.

"Compo" Pulley and Clutch.

The accompanying halftones illustrate some interesting applications to pulleys and friction clutches, of cork inserts

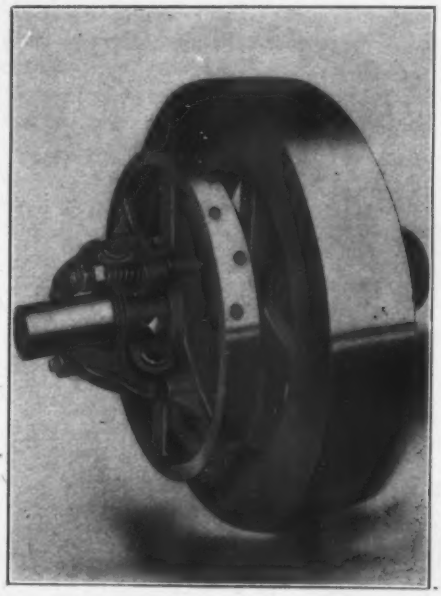


FIG. 2. MACHINE CLUTCH.

which with the wood or metal surrounding them form a composite ("Compo") surface giving increased efficiency for driving over the plain surface. The proprietors of the system, the National Brake & Clutch Company, Boston, Mass., do not manufacture pulleys or clutches, but under their patents licenses are granted to pulley manufacturers and others who wish to apply the cork inserts to their apparatus.

The cork is used in its natural state, compressed into pockets and held in place by expansion. Wood pulleys are of course easily arranged to receive the inserts. In the case of iron pulleys, it is

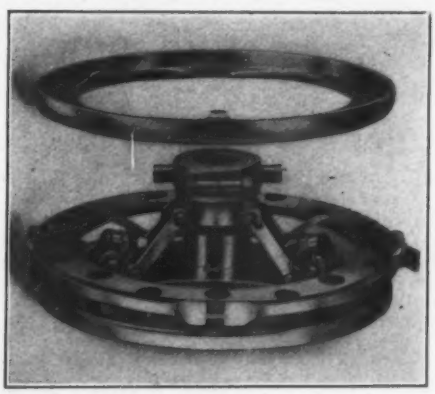


FIG. 3. THE AUTO CAR COMPANY'S CLUTCH WITH CORK INSERTS.

necessary to core the sockets for the cork, these being made about 7/16 inch deep. On light-rimmed pulleys a reinforcement of wood or other material inside the rim gives the necessary body for the reception of the cork plugs.

As indicated in the engravings, which represent in the order named, a belt pulley, a machine clutch, an automobile clutch and a group of friction blocks, the cork inserts are placed in position with their faces nearly flush with the metal or wood surface.

In operation, the cork not only grasps the surface with which it comes in contact, but also gathers up dust and abraded particles which under other conditions act as rollers and cause slipping by keeping the surfaces apart. Curiously enough the cork wears down no faster than the metal in which it is embedded. It is stated that the friction of the "Compo" clutch surface is not affected by either water or oil. For railway brakes the composite surface has long been successfully used.

Some tests of loom clutches made at the Worcester Polytechnic Institute showed that at the same pressure of clutch, the "Compo" clutch (cork inserts) transmitted 96.48 pound feet of torque as against 47.56 pound feet for the standard leather-faced clutch, and this with smoothness of engagement and without gripping or seizing; and that at one-half the pressure the "Compo" clutch transmitted equal torque. The average results of over 100 pulley tests made at the same place showed for an 18-inch iron pulley with cork inserts an increase in power-

FIG. 4. FRICTION BLOCKS.

transmitting capacity of 51 per cent. over plain iron pulleys of the same diameter.

Catalogs for the Foreign Trade.

One of the most perplexing questions confronting a manufacturer dealing with foreign trade is that of the preparation of proper catalogs. I am aware that some few export houses do not issue such catalogs at all, denying that there is any commensurate return for the money thereby expended. But the majority of business houses catering for foreign orders have agreed that catalogs are necessary and it is to such firms that the following remarks are addressed:

I need hardly say that it is useless to send catalogs in the English language to foreign markets. I should hardly have mentioned such an obvious truth were it even now not unusual to find some American firms still publishing their export trade literature in English. Whatever is the good of sending a Chinese, Russian, or other foreigner a bulky volume prepared at great cost, which he cannot read when

he gets it? Need I say more on this head? British firms are steadily leaving the beaten track and are issuing their literature in the language, etc., of the market they are addressing. Assuming that you are about to adopt the common-sense course, the fact must never be lost sight of that accuracy in the translation is imperative. It is the first and the last essential. Unless the work is done very carefully and by thoroughly competent people it had better not be done at all. A catalog is, so to speak, the silent representative of the firm whose name it bears, and unless the translation is quite correct, it will excite only ridicule and contempt. Not only is it necessary for the translator to have a thorough knowledge of his own and the language into which he is translating, but he must have a technical knowledge, which is almost a separate language. And he should also understand the machine he is describing and have, if possible, a knowledge of the foreign market he is dealing with. I want to make it clear that a mere literary accomplishment is useless by itself, and that is the rock upon which so many engineering catalogs are wrecked. Some catalogs from British and American firms are circulated abroad that are not only unintelligible, but ridiculous, simply exciting the laughter of their readers. Illustrations of the machine referred to should be given, with full descriptions of its construction, operation, advantages, range of work, and application. Net and gross weights should be given in kilograms—or whatever may be the national system in vogue—and not in pounds; dimensions in meters and centimeters; pulley diameters and widths in centimeters; and speed in revolutions per minute.

The capacity of the machine per hour and the character and cost of the labor required to operate it are also very necessary pieces of information. Pieces should be quoted c.i.f. wherever possible. I should not omit to warn all exporters, and especially manufacturers, to protect carefully all rights in their machines or goods before sending illustrations of them abroad, because anything good is quickly appropriated by the intelligent foreigner,—no matter whether he be a German, Japanese, or, say, Briton.

Complaints are often made that catalogs do not give prices. In cases where the information can readily and quickly be supplied, it does not matter so much, but in far distant markets, where the expense of cabling is considerable, the omission is frequently fatal to business. Exporters should adopt some means whereby the recipient of a catalog can tell, at any rate approximately, what a machine will cost. Some time ago a gentleman in one of the French possessions abroad had occasion to call for a number of catalogs, dealing with steam engines and fittings. He received scores of catalogs, but only a very few gave prices. The result was that while a number of orders were placed, the goods were in several instances ordered from people who had quoted prices, although articles shown in the catalogs without prices would have been preferred. Foreign merchants quite understand that prices are liable to alteration, as prices of raw material vary, but they very reasonably want some price quoted so that they can make calculations. People abroad want to have all the information before them when coming to a decision. Many of them simply will not write home saying exactly what they want and have to await the reply for weeks for the price, etc. They want to be able to figure out from data before them that the article will cost about so much and then order it. Most of the Continental manufacturers understand this trait of character and conform to the requirements of their prospective clients.

It is equally a mistake when supplying catalogs not to quote all discounts allowed. This is recognized by foreign merchants, who generally quote all discounts. The failure to do so is very liable to mislead the recipient, with the result that the business will go elsewhere. This omission is to be found in British, American and sometimes foreign catalogs, but it is none the less reprehensible for all that. Indeed, it would appear that American firms are rather prominent offenders, as complaints are by no means rare that your catalogs do not state what discounts are allowed off prices quoted. Of course the discount is often the essence of the matter. One of the leading importing firms in China complained some time ago that in all the American lists they received not one of them stated the terms.

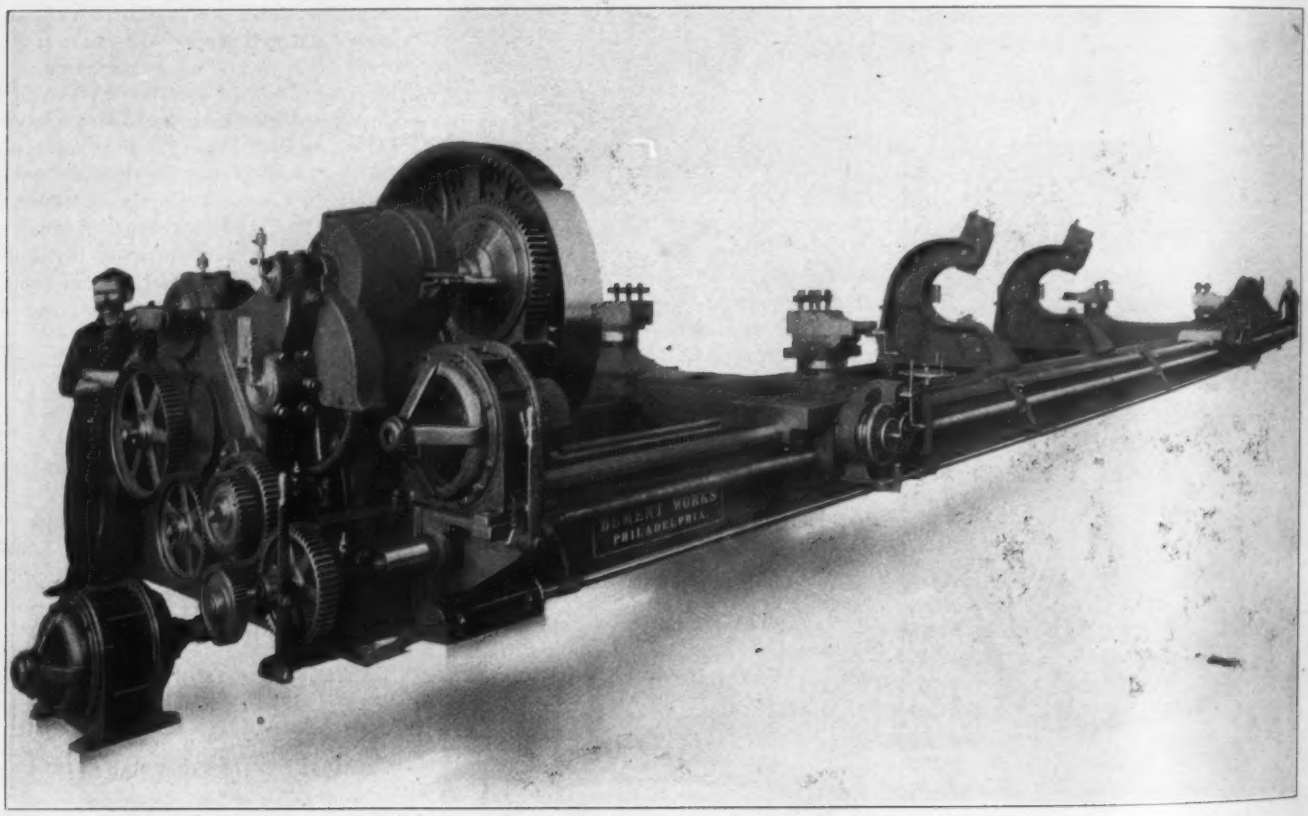


FIG. 1. 84-INCH LATHE WITH LONG BED.

Many of such productions, indeed, appeared to be meant for use by the general public and not for wholesale houses. Whenever prices are quoted it should be stated definitely whether they are wholesale net prices. If this is not done the information, so far as it goes, is next to useless.

If American firms offend in some respects they certainly score in others. For instance, in the matter of illustrations, your catalogs are often better illustrated than the English ones, and sometimes the arrangement is superior. This may occasionally give your goods the preference, other things being equal. Your exporters often prepare their catalogs for the special benefit of a particular class of buyers; the information they supply being in such cases very complete, not only specifying the construction and particulars of the parts of the machinery but actually giving much infomation as to the working of the machines in question, with a lot of miscellaneous particulars likely to be useful to the prospective buyer.

For example, a firm of American carriage makers sent some catalogs to Malta, a market they were trying to cater for. The catalogs were replete with illustrations; with each illustration was a large amount of descriptive matter. Prices f.o.b. New York were given, and even the cubic measurement of each article crated, also the weight and the rate of freight by steamer to many ports in foreign countries. The information was so complete that a favorable impression was created and business was much facilitated.

London, Eng. F. C. C.

The Roumanian Government has just passed a patent law of rare simplicity, without examination and without any guarantee of novelty, utility or legality. Inventions connected with war, or Government monopolies can be appropriated by the Government on such terms as the court may consider just.

An 84-Inch Engine Lathe With Long Bed.

This machine was built for handling long marine shafts and will take 80 feet between centers. The bed is 92 feet long. With a machine of this length it is essential that the carriages have rapid traverse along the bed and this is accomplished by means of an independent 7½ horse-power motor. A 25 horse-power alternating-current motor is used for the main drive and a large number of spindle speeds varying from .42 to 40 turns per minute are provided through gearing. The swing over the bed is 84½ inches and over the carriages 51½ inches. The two carriages have gap pieces which may be removed when turning large work, thus increasing the swing to 72 inches, and are provided with front and back tool rests. This lathe was built at the Bement works of the Niles-Bement-Pond Company.

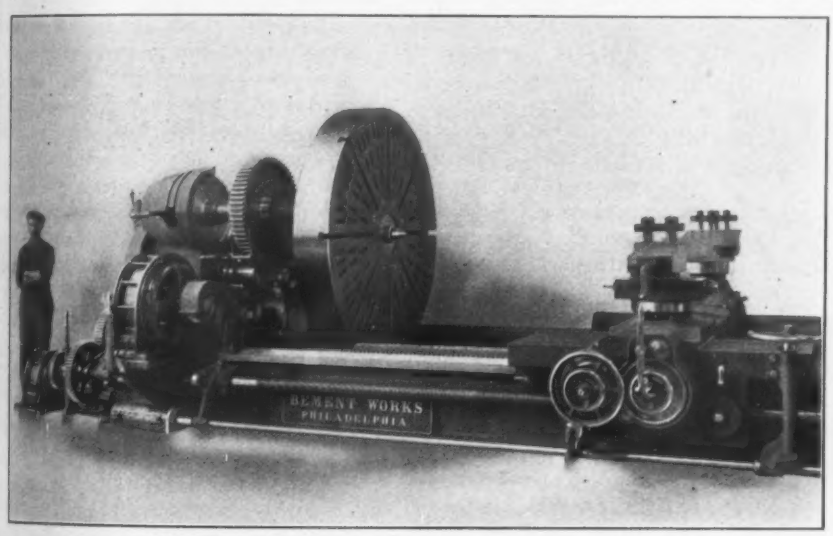


FIG. 2. SHOWING LATHE HEAD AND CARRIAGE.

Legal Notes.

BY E. P. BUFFET.

REVOLVING CRANE, CONTRIBUTORY NEGLIGENCE.

A rougher at the rolls in a tube company's mill brought action on the ground that he had been struck by a revolving crane and his hand crushed. He alleged that the socket was worn so that the mast slanted and in a certain position swung part way around automatically and vibrated back and forth. It appeared, however, that the crane had been in this condition for three or four months, during which time the man had worked in its immediate vicinity. The Supreme Court of Pennsylvania holds that, while the case comes under the rule of duty to furnish a safe place in which to work, the man's recovery is barred by contributory negligence, since it thinks that the defect would have been apparent to any person who used his eyes.

62 Atl. Rep., 985.

UNGUARDED EMERY WHEEL; DAMAGE FOR LOSS OF EYE.

A workman brought action against an Indiana company on the ground that he had been employed as an engineer and later given some jobs at an emery wheel and had lost one eye as a result of an injury from small particles of material; that the wheel was not properly guarded with a hood or provided with a fan exhaust and that he had not been supplied with eye protectors. There is an Indiana statute which requires factory emery wheels to be furnished with exhaust fans to carry off dust. When action was brought the jury in the Circuit Court allowed him $146.75 for medical services and $178.75 for other expenses. Judgment on the verdict has been affirmed by the Appellate Court.

76 N. E. Rep., 770.

POWER-HOUSE NUISANCE—WHO MAY RECOVER.

Suit in equity for damages and other relief was brought by certain persons against an electric light company in New York City, for discharging "soot, cinders, ashes, steam or water condensing from steam" upon the neighboring premises belonging to these parties and causing noises, jars and vibrations. They had leased their property to a tenant and subsequently renewed the lease at a lower rent. The question arises whether they, as owners, had any right of action against the company for diminution in rental value or could only the tenant sue for damage to his interest in the premises? The trial court awarded damages to the owners, and has been sustained by the Appellate Division, but the Court of Appeals, by a vote of four to three, has reversed that decision and ordered a new trial. Chief Judge Cullen, delivering the prevailing opinion, rests in part upon a distinction between a case of permanent nuisance, such as an elevated railroad, or even a case of injury to the walls of a house due to the operation of a power plant, and one like the present where the nuisance is casual and temporary. Further, he points out, the matter complained of was not necessarily or inherently injurious, since the trial court had found that at a time subsequent to the commencement of the suit, and after the neighborhood had changed in character, the operation of the plant did not appear to be still causing damage to the owner of the property. Judge Gray, in a dissenting opinion, combats the view that the nuisance was of such a nature as to be considered casual and temporary. He thinks the owner should have right of recovery of loss of rent. Properly to understand this case, however, the report should be read at length.

76 N. E. Rep., 734.

American Inventors in the German Patent Office.

One of the vexed and burning questions with American inventors, as many of those in the electrical field are aware, is the alleged difficulty of securing fair and even proper treatment at the hands of the Imperial Patent Office, when taking out patents in Germany. So far as we know, up to this time no explanation of apparent injustices has been forthcoming and so the situation has slowly drifted into one of bitterness and estrangement, and American inventors have said that it was useless to try to get decent consideration in the German Empire. This belief has seriously affected the efforts of American inventors and capitalists in pushing into the German market, and has undoubtedly done great harm in provoking ill-will between two great countries that have so much in common, and so many good reasons for being close friends.

Dr. Alfred Müller, a well-known solicitor of foreign patents in New York City, and an expert in German patent law, was not at all satisfied with this "deadlock," and entertaining the opinion that one of the ways to cure an evil was to ascertain its extent and real nature, wisely addressed himself to the principal authorities, rehearsing what he understood to be the actions on one side and the grounds of complaint on the other. That letter, written some months ago, has evidently been the subject of study and discussion in the German Patent Office, as we are now able, through the courtesy of Dr. Müller, to give the reply of President Hauss to his communication. We give this highly important document below in English and trust that its appearance in our pages may be the first step toward that harmony and better understanding which always follow when two well-meaning parties to a dispute get a clearer comprehension of the status and arguments of each other. The letter of President Hauss follows:

Your favor of December 27, 1904, touches some questions which, independent of your statements, have been made the subject matter of fundamental considerations in the Imperial Patent Office. These considerations have only been recently brought to a definite close, so that now I am enabled to answer your letter. I assume that an answer, in spite of the delay due to the circumstances, will still be even to-day of some interest to you, and I for my part will gladly make use of an opportunity to explain misunderstandings which seem to be prevalent among American interested parties concerning the practice of the Imperial Patent Office.

In complaining about a too severe definition of the term "invention" you refer especially to the fact that the proof of a "new technical effect" is lately more often required than it appears advisable according to circumstances.

Concerning this point I beg to remark that the said phrase often should only be regarded as an expression to the effect that in the opinion of the examiner there is lacking in the subject matter of the application any considerable effect. Such an estimate, whether the invention, in as far as it is new, exceeds that which also an "ordinary workman" is able to do, must be left to the examiner and the departments of the Patent Office. It is of less importance than the expression that is used by the Patent Office in refusing a patent. However, I have taken care that the phrase requesting to prove a new technical effect is limited to those cases in which an industrial process does not come into question except from the mechanical viewpoint and when the stated technical effect is so improbable that a proof must be demanded.

In the matter itself, the Patent Office does not finally decide as to the standpoint which is to be taken in the estimation of the subject matter of an application as an invention. In the proceedings for the annulment of a patent this question is rather subject to the judgment of the Supreme Court. This institution has set down a series of principles concerning the definition of the term "invention" in numerous decisions which partly have caused the annulment of the patents, principles which the Patent Office cannot leave unobserved in its proceedings for the granting of patents without great injury to the interested industrial branches.

However, the Supreme Court as well as the Patent Office do not at all assume the severe standpoint which is characterized in your letter and the enclosures. If for instance it is said that in Germany "every invention must contain a new principle" or that "that which does not radically differ from a known principle will not be protected" or that "an application is rejected if the theoretical effect is anticipated" or that "the theory of technics is more advanced than the practical side of the industry," or that "an invention is not patentable if the combination contains even a single known element," these are exaggerations which are shown to be such by the reading of German patents, and by the fact that about 10,000 patents are annually granted in Germany, whereas nobody will say that fundamental new inventions are remotely made in any such number.

All this is true of applications by American inventors and in the same degree of applications from other countries, and particularly of Germany. The reproach which is so often made, I regret to say, by Americans, and is also repeated in your letter, to wit: that American applicants are worse treated than Germans must be positively rejected as not based on facts. According to the *Official Statistics*, patents were granted on applications from Germany in 1901, 6,609; in 1902, 6,334, decrease, 4.2 per cent.; from the United States, in 1901, 1,094; in 1903, 1,069, decrease, 2.3 per cent. The decrease of patents, therefore, granted to American applicants was about half as large as that for German.

Moreover, the absolute decrease of granting of patents in both countries is no proof, since only the proportion of the patents granted in a certain period with relation to the applications disposed of in the same time can be taken as a true gauge as to better or worse treatment. In this respect separate statistics for the single countries have not been made. If, however, the applications of a certain period are to be compared with the patents granted in the same time, it is shown that on 100 applications of the German Empire an average of 34 patents were granted in the years of 1901 to 1903, whereas on 100 applications from the United States an average of 59 patents were granted, as shown by the statistics referred to. In the year of 1904 the proportion had become still more favorable with respect to the United States, for according to the latest statistics only an average of 31 patents were granted on 100 applications from Germany in the years of 1902 to 1904, whereas on 100 applications from the United States during the same period an average of 59.1 patents were granted.

How in view of these official figures a worse treatment of American inventors can be continually spoken of is beyond understanding. I leave it to you to give a very large circulation to the figures which show the injustice of such an opinion.

It is true, however, that American applications present special difficulties to the Patent Office in Germany and make constantly repeated criticisms necessary. The reason lies in the difference of the laws and rules of practice of the two countries, and also in this that American inventors and their representatives often think that they can demand that their applications filed in Germany shall be treated according to the laws and rules existing in America. It is very often the case, I regret to say, that, be it at the express wish of the applicant, or be it on account of the lacking experience and the carelessness of the representative, an application is filed here in the same form and with the same claims as it has been filed with in America. The papers, therefore, are not prepared in such a way as to take into consideration the differences between the principles existing in Germany and in the United States. This means a great and unnecessary burden for the German Patent Office. *The American inventors are themselves to blame for the delays which result from their actions.* They cannot demand that the German Patent Office shall cease to enforce the German rules of practice. How far in this direction the baseless demands go is shown by the letter of a firm in Philadelphia enclosed with yours, which

firm expresses the desire "that such applications as have passed the rigid examination here could be allowed without further trouble in Germany, unless some new and better reference could be discovered."

If this is meant really in earnest, it cannot even be discussed. The German Patent Office, as long as a treaty does not provide for the contrary, is justified, and is obliged to examine American inventions with respect to the fulfilment of German requirements, just the same as German applications in America are examined by the corresponding authorities of the United States.

In this respect reference should be made to the report of the United States Consul-General, Frank F. Mason, dated September 9, 1901, printed in the Consular Report, Vol. 67, No. 254, page 337, etc. There the true causes of the delays, to which American inventors subject themselves in their dealings with the German Patent Office, are shown by a person whose fairness of judgment should certainly be recognized in America. The reading of this report cannot urgently enough be recommended to those of your countrymen who believe themselves to have a reason for complaint, concerning the treatment of their German applications.—*Electrical World and Engineer.*

Relics of James Nasmyth.

We gave some account of James Nasmyth's life in *The Engineer* on May 16th and 23d. 1890, just after his decease, from which it will be gathered that, although associated primarily with the introduction of the steam hammer, the improvement of machine tools was a great feature of his useful career, and it will interest our readers to know that some interesting machine tools, formerly his property, have lately been placed on view in the Southern Galleries at South Kensington Museum.

One of the objects is a planing machine, made in 1857, but in arrangement and detail almost identical with some of the larger machines built by Nasmyth and Gaskell about 1840. At that time such machines were generally rack-moved, with quick-return motions, but for sizes up to 3½ in. wide by 8 in. travel the gear shown in this example was considered to give a quieter and quicker action. The frame is a somewhat massive casting, with two V guides having the apex upwards, so that, though not retaining the oil so readily as the later shape, they did not form receptacles for dirt. The two standards are bolted to the main framing and connected by a cross girder which carries a central screw by which the height of the cross slide is adjusted; the latter has an internal traversing screw for moving the tool rest, which is capable of angular adjustment and has a hand-feed motion. The tool-holder has the usual hinged box for preventing damage to the tool on the return stroke.

The table of the machine is a single casting, with slides planed on its lower surface corresponding with the fixed guides; the upper part has six longitudinal T-headed grooves for receiving the bolts which secure the work. The table is moved to and fro by a mangle-wheel motion, two chains passing from the lower side of the table over fixed guide pulleys down to a chain wheel, round which they pass in opposite directions before being secured; the shaft of this wheel carries at one extremity a wheel with lantern pins or teeth, into which a small pinion on the driving shaft gears. The pinion end of this shaft is carried in a sliding bearing, so that the pinion gears alternately inside and outside of the segmental lantern wheel, thus reversing the motion after a definite length of travel has been effected. The length of stroke can be permanently altered by removing from the mangle wheel some of its teeth, which are single pins secured by nuts. In the machine shown a hand-driving mechanism has been added, and the loose pulley removed. The transverse travel of the tool-box is automatically given by a pawl feed, receiving its motion from the lateral play of the pinion shaft.

The machine above described is of considerable size, and stands alone in the gallery. Near it in a glass case are a drilling machine and a shaper, which both belonged at one time to Mr. Nasmyth. They are beautiful specimens of workmanship. The driller is much like those constructed about sixty years ago, spindle overhanging, in the manner now generally adopted. The framing consists of a base with two columns supporting a cross-girder, which carries the drill spindle and its driving and feeding arrangements. The power is transferred through mitre wheels to the drill spindle, which is fed downward by a central screw supported by a cross-head carried on two small wrought iron columns. This screw is fitted with a winch-handle for feeding it downwards by hand; there is also an automatic feed given by a vertical shaft that is intermittently rotated by a pawl worked by an eccentric on the lower end of the spindle sleeve. In the larger machines of this kind step driving pulleys were used in connection with an independent work-table having horizontal screw adjustment in two directions.

The shaper is an early form of hand-worked machine, the driving shaft terminating in a disc in which is a slot carrying an adjustable crank pin, by which the length of stroke can be varied. This pin is fitted with a block capable of sliding in a vertical slot formed on a horizontal ram, that carries the tool-box; the ram works in adjustable V guides, and is fitted with a vertical slide in which the tool-box is fed by hand. The work-table slides on guides on the front of the main casting and is traversed by an internal screw driven by hand power, or automatically, by a pawl feed motion rocked by an eccentric on the main shaft. The table is fitted with a vise, and there is also an arrangement for holding square and hexagonal nuts while being shaped. The machine has a heavy hand wheel of brass, and is fixed on a wooden stand about 18 in. square.

Just before these are reached—coming in from Exhibition road—is a curious old copperplate printing press, once owned by James Nasmyth. The date and the maker's name are alike wanting. It has two adjustable housings of cast iron, cerrying a 6 in. diameter roll below and a 2-in. roll above. Between the rolls is a traveling wooden table, faced with iron plate, which rests on the lower roll, and also upon four loose supporting and guiding rollers. The inked and cleaned plate being placed on the table, and covered with a damped sheet of paper, upon which is placed some blanketing, the whole is then passed between the rolls, while the upper roll is being turned by a long double-ended hand lever. This lever is now of wood, and not able to bear, apparently, very much strain, but possibly the original was stouter, or made of metal. The arrangement gives a powerful squeeze without subjecting either plate or table to any bending stress. The general construction of the press is not very different from that of a modern hand press of equal size, whilst the roller arrangement is one of great antiquity. None of these relics yet in the official catalogue, for though acquired by the Museum in 1899, it has only lately become possible to exhibit them to the public.

—*The Engineer.*

C. H. Blackall, in conjunction with A. G. Everett, made a thorough investigation of the actual existing live loads of three office buildings in Boston. These loads were obtained by taking the actual weights of the furniture and contents and the greatest number of people known to be at any one time in an office, the average weight of one person being estimated at 150 lb. The greatest load was found in one of the offices of the Ames Building, amounting to 40.2 lb. per sq. ft. In only 12.4% of the offices was the floor load in excess of 25 lb. per sq. ft., and in only 26% did it exceed 20 lb. per sq. ft. The greatest maximum average for all floors of any one of the three buildings was 17 lb. per sq. ft.

Quicksand should never be used on which to build foundations. Wet sand will frequently bear from 4 to 6 tons, as long as it is confined.

A load of 6 tons per sq. ft. on any but the hardest kind of gravel, and then only when it overlies rock, is apt to prove excessive.

Unemployed Workmen Law in England.

Consul Mahin, of Nottingham, reports that the authorities of that city have appointed a distress committee, under the act of Parliament regarding measures for the relief of unemployed workmen. Mr. Mahin writes:

The Nottingham city council has appointed the local committee prescribed by the unemployed workmen act of the recent session of Parliament, and has taken other measures to effectuate its provisions. The act does not contemplate any interference with or enlargement of the powers and duties of the existing guardians of the poor nor relief by gifts of money or goods. It is designed merely to assist people out of work to make their own living. Pursuant to the provisions of the act, the Nettingham council appointed 16 of its own members, 12 from the local board of guardians, and 7 from persons experienced in the relief of distress—35 in all—as a distress committee.

POWERS AND DUTIES.

The powers and duties of this body, as prescribed by the law, amplified and clarified by rules and regulations of the local government board, are substantially as follows:

(1) Obtaining information with reference to the unemployed. This information is to extend to a large number of particulars to be entered in a record paper. The distress committee are also to keep a register for recording the names, addresses, and particulars of each person who makes application. They are also to keep at all times ready for use an alphabetical index. The committee are required by their officer or by one of themselves personally to investigate every application, and when necessary to communicate with the board of guardians thereon.

(2) Under certain conditions the distress committee may aid emigration of an unemployed person and his dependents. The committee, however, can only aid emigration when it is ascertained that the unemployed person will be forthwith put into a position to obtain regular work or means of supporting himself and any of his dependents.

REMOVAL OF UNEMPLOYED.

(3) The distress committee can aid the removal of the unemployed to another area within the limits of England and Wales. This power, however, is limited to those cases in which the unemployed will be put at once in a position to obtain regular work, or other means of supporting himself and any of his dependents, and in which suitable dwelling accommodation for the person or persons to be removed can be provided at the place of destination. Further, that such regular work will be of such duration or that the facilities for other employment will be such as to afford reasonable expectation that the persons removed will not become chargeable to the poor rate at any time during the period of twelve months after such removal.

(4) The distress committee may provide or contribute toward the provision of work. This power, however, is limited by stringent conditions. The work must be of actual and substantial utility. Each person employed must be subject to effectual supervision. Each such person must perform every task allotted to him with diligence, and must attain a certain standard of efficiency. Each person shall be employed as far as possible continuously, with such absence only as may be necessary to search for work elsewhere. Under certain conditions the distress committee must satisfy themselves that the cost for lodgings and maintenance of the wife, children, and dependents will be defrayed by deductions from the remuneration of the person employed. There are other conditions also as to the total remuneration which may be earned by unskilled laborers. In no case may the provision of temporary work continue for longer than sixteen weeks in any period of twelve months, except with the consent of the local government board. The distress committee can contribute toward the provision of temporary work in those cases only in which the work is provided by a local authority or public body.

FARMS AND COLONIES.

(5) The distress committee may establish a farm colony. This can only be done with the consent of the local government board, and such information must be supplied to that board as will enable the members of that board to satisfy themselves as to the propriety of such a step, and that all expenses incurred in connection with the establishment, maintenance, and working of the farm colony may be reasonably expected to be defrayed out of voluntary contributions or otherwise than out of contributions by any council. If a farm colony is established powers are conferred upon the distress committee, with the consent of the local government board, to provide accommodation for persons working upon the land The local government board are to be satisfied that the cost of such temporary accommodation will be supplied by voluntary contributions.

(6) The distress committee is authorized to accept donations. The accounts of the distress committee are to be audited by an auditor appointed by the local government board with powers of surcharge.

There are provisions enabling the distress committee to borrow money for the purchase of land.

The powers of the distress committee are confined to applicants who are of good character who have not sufficient means of maintaining themselves and their dependents, and who have not during the period of twelve months immediately preceding the date of their application been in receipt of relief, other than medical relief, at the cost of the poor rate.

It is expected that the operation of the law will add a penny in the pound (equivalent to about 4 mills on the dollar of assessed value) to local taxation. It is hoped, however, that the brightening trade prospects will tend to ease the committee's work.

General public opinion as heard in current talk is hardly commendatory of the law, passed, it is declared, merely to satisfy a hard-times clamor for relief. In any case, the situation bristles with all sorts of difficulties, and the various distress committees have a perplexing task on their hands.

* Daily Consular and Trade Reports.

One great advantage of rolled steel for building work is its accessibility to inspection at every stage, and cast iron, if used at all, should be similarly accessible. To illustrate the need of this inspection, one need but glance at the advertising pages of any foundry journal, where such names as "Smooth-it-over," "Pile-it-on," or "Filler-up" are given to substances sold for the purpose of concealing defects in castings. The foundry-man welcomes visitors to inspect the mysterious methods of sand or sweep molding, or to witness the sprays of sparks that fly from the molten metal while a heat is being taken off at night, but one should see the result in the "cold gray dawn of the morning after," before it can be doctored.

In view of the extremely short time usually allowed an engineer for designing the structural portion of a building, any general information which can be embodied in the specifications, or any clause which will lessen as much as possible the amount of calculation involved, will contribute to save valuable time. In the matter of dead loads it seems as if, considering the large number of well-known systems of floor construction, they might be divided into groups or classes with an approximate dead-load value for each class, as, for example, flat-tile arches, segment arches, concrete slab construction, etc., to include in each case the weights of all the material to make the finished floor.

In practice it is the concentrated loads which determine the strength or safety of the floors and building. Uniform loads sufficiently high to cover the concentrated loads, produce wasteful construction, without any compensating benefit to the building.

The "dead" load in structures consists of the weight of walls, floors, partitions, roofs and all other permanent construction and fixtures.

Epochs in Marine Engineering.*

BY GEORGE W. MELVILLE, REAR-ADMIRAL, U. S.N., RETIRED, PHILADELPHIA, PA.

1. To attempt to cover the history of marine engineering in a lecture which ought not to pass much longer than an hour would result in little more than a mere chronology and could not possibly be interesting. It seems much better, therefore, to give some consideration to the various periods or epochs in the history considered with reference to the special inventions or changes which have characterized them. Many of these changes are clear examples of evolution and others are instances of the adaptation of land practice to marine use, but they all serve to show the constant progress which has taken place.

THE PADDLE WHEEL.

2. The first marine engineering in the modern sense was the adaptation of the steam engine as already in familiar use on shore to a modification of the centuries old method of mercantile propulsion, the oar. I believe some attempts were actually made to adapt the steam engine to a series of oars, which would have meant something like a mechanical trireme; but of course the trained mechanical sense soon saw that the collection of the oars in a revolving wheel was the correct solution. As oars had been used on both sides, so it was natural at first that the paddle wheels should be on both sides, a center wheel was also tried, but it is interesting to remark that practically about the same time that the side-wheels were used on the seaboard, the first marine engine was the shore engine modified to suit the circumstances, and thus on the seaboard the engine was designed and worked with what we now consider an exceedingly low pressure. On the western rivers, where the change has been made in the location of the wheel, there was also the additional change of dispensing with the condenser and using very much higher pressures. It was doubtless due to this fact—that the first non-condensing engines really carried a very high pressure—that the term "high pressure" in the early days meant non-condensing. The reason for the difference is of course very clear; the western rivers are very shallow and it was necessary to make the machinery as light as possible; on the seaboard and the rivers of that section there was deep water and the vessels had displacement enough to permit of heavy machinery.

3. Ordinarily the history of this olden time could have only an antiquarian interest for us, but we are unusually fortunate in still having with us in the active practice of his profession an engineer who saw the first commercially successful steamboat, the "Clermont," so that through our "grand old man of engineering," Mr. Charles H. Haswell, we still have a living connection with that earlier time. One of my former assistants some years ago contributed a series of articles to one of the engineering magazines and has given some data as to the performance of the "Fulton," the first American steam man-of-war, whose machinery was designed by Mr. Haswell, who was also her first chief engineer. An extract from the "Fulton's" steam log for January, 1838, shows that the maximum steam pressure was eleven pounds, the vacuum twenty-four inches and the maximum revolutions per minute eighteen.

THE SCREW PROPELLER.

4. As time passed on and experience was gained, there was naturally an improvement in workmanship and design and a moderate increase in steam pressure, but about 1836 the screw propeller was brought forward for driving large vessels. This was not the first application of the screw propeller, which had been used successfully on a small steamer or launch about 68 feet long as early as 1804 by Col. John Stevens, the grandfather of Col. Edwin A. Stevens, who is now so active in marine work, and the father of Robert L. Stevens, who was the most famous of the name for his work in connection with marine engineering. It is to be noted that this date is prior to that of the building of the "Fulton," but naturally, in the first steam war vessel, it was not considered desirable to do anything of an experimental nature, a condition which has obtained to some extent ever since and probably always will. It was about ten years later that the propeller began to come into general use and entirely displaced the paddle wheel for ocean-going steamers. The reason for this change is easy to see on a little consideration. On a long ocean voyage the change in displacement is due almost entirely to the consumption of fuel. In the case of the propeller this makes practically no difference in its immersion, or in its efficiency, while in the case of the paddle wheel the immersion of the floats would be changed, with a diminution of efficiency. Further than this, the paddle box offered very great resistance to strong head winds and also brought severe stresses on the ship, due to rolling in heavy seas, the propeller not being affected by either of these last two causes. To-day for work in deep water, the screw, of course, is the only propeller; but for river work, particularly in shallow rivers, the paddle wheel is still used. Efforts have been made, and some of them exceedingly ingenious, to adapt the propeller to use in shallow water, and a certain amount of success has attended the efforts of such brilliant engineers as Yarrow and Thornycroft, not to mention our own Mr. Charles Ward, who has done some work in this connection. The fact remains, however, that damage by sand bars, snags, etc., may easily render screw machinery inoperative, while, as expressed by an engineer who had designed many western river boats, "any wood butcher can repair a stern wheel."

5. Probably fully as much has been done to improve the design of propellers, as time has gone on, as any other part of marine machinery. In the early days the rules for propeller design were exceedingly crude, but with the slow engine speeds which then obtained the effects were not noticeable. As engine speeds increased, however, it was seen that these old rules were utterly inadmissible. There is no good excuse, however, for progress having been so long delayed, for the designs still remained too crude even after Isherwood's famous Mare Island experiments in 1868. Probably one of the great troubles with screw propeller design at the beginning was the mistake made in considering the action of the screw as analogous to that of a bolt working in a nut, from which it was inferred that the smaller the slip the greater the efficiency. As a matter of fact, a screw propeller is really a pump for driving a mass of water astern, the reaction from which drives the vessel ahead. When this had once been realized, it was seen that there must be a certain amount of slip and that under proper conditions there could be a relatively large slip and still high efficiency.

6. Multiple screws were used as early as our Civil War on some vessels known as "tin-clads" on the Mississippi, their adoption being necessitated by the shallow draught. Twin screws were first used in war vessels where the necessity for keeping the machinery below the deck would not allow of all the power being conveniently used on a single shaft, but the great advantage they possess of security against total disablement and for manœuvering soon made them the rule for all naval vessels large enough to admit of them. They were much longer in coming in the merchant service where the limitations on naval machinery do not obtain, but since the era of the very large trans-atlantic steamers beginning with the "Paris" and "New York" and the "Teutonic" and "Majestic"—all very large vessels have been built with twin screws.

7. In the navies of France and Germany the triple screws have been used to a considerable extent, and I used them myself in our own fast cruisers "Columbia" and "Minneapolis." My own belief is that they have decided merit for vessels using about 10,000 horse-power. This view, however, was not shared by my Board colleagues in the Navy Department, so that their marked success in

*Presented at the meeting (June, 1905) of the American Society of Mechanical Engineers, and forming part of Volume XXVI of the *Transactions*.

the two vessels named was not allowed to be repeated in later designs.

8. With the advent of the steam turbine as a prime mover in ships, multiple screws have again come to the front, this time on account of the extremely high speed of rotation of the shafts. The "Turbinia," the first vessel of this kind, had three shafts with three propellers on each; and the destroyers "Viper" and "Cobra" had four shafts with two propellers on each. The merchant vessels, beginning with the "King Edward," have been fitted with three shafts.

9. Before leaving the propeller, I may mention, in connection with the improvements in its design, the care that is now taken to avoid needless friction by making the hub spherical with a conical tail piece, and by putting covering plates over the bolts, securing the plates to the hub so as to continue the outline of the sphere or conoid.

THE SURFACE CONDENSER.

10. Up to about 1860 the jet condenser was the one usually employed on board ship, which meant, of course, that the boilers were constantly fed with salt water; and this in turn meant the deposition of great quantities of sulphate of lime scale on the heating surface. With the low pressures then prevalent this did not greatly affect the economy of the boilers, except that, as "blowing off" to keep the density of the water down was a continuous practice, there was a certain loss of heat, and of course there was the necessity for frequent scaling of the heating surfaces. However, they were effectually protected against corrosion. About 1860 the use of surface condensation became general, and as this greatly reduced the amount of scale formed, it was practicable and safe to increase steam pressures, which accordingly resulted with a consequent reduction in the weight of machinery per unit of power.

11. An accompaniment of the introduction of surface condensation, which was at first supposed to be a result of it, but which as a matter of fact was not, was a tremendous increase in the corrosion of the boilers and shortening of their life. This was especially noticeable in the tubes which, as the thinnest part of the boilers, give out first. All sorts of theories were advanced to account for it, some of which we can now see to have been utterly ridiculous. Probably one of the most fanciful was that which regarded the boiler and condenser as forming a gigantic galvanic battery, the copper condenser tubes forming one pole and the boiler the other. The real facts were developed as a result of the investigation by the Admiralty Committee on boilers in the 70's, which showed that boiler corrosion was simply rusting and had been due to gross but unintentional neglect.

It had been a very common practice, particularly in naval boilers, when they were not in use, to blow out the water and take off the manhole plates "to let them air." It was this "airing" which caused the corrosion. Now when boilers are laid up, they are filled with water which is made slightly alkaline, and this effectually prevents corrosion.

THE CYLINDRICAL BOILER.

12. The early boilers in sea-going vessels were of what has been called the "box" type; that is, the boiler was a cubical box with a thin shell, the real strength being given by braces running in three directions. When surface condensation had made higher pressures possible, it was soon found that the multiplicity of braces, as pressures were increased, made an impossibly condition of affairs, and this led to the design of the cylindrical boiler whose shell was self-bracing and left the only braces, those needed for the heads and flat surfaces. This boiler so thoroughly met the conditions arising that it has remained the favorite even up to the present day. At one time an effort was made to save room by making the boiler elliptical, but this was soon found to be unsatisfactory and impracticable and was abandoned after only a few examples.

13. The earliest cylindrical boliers were single-ended with two furnaces, but with the advent of reliable mild steel the diameters were increased and the boiler was made double ended, with upper ends rounded to save bracing, so that the largest cylindrical boilers to-day have as many as eight furnaces, four in each end in pairs; that is, the two furnaces at each end on the same side of a vertical diameter have a common combustion chamber. The saving in weight due to the double ended boiler is evident at once and also the reduction in the feeding apparatus required

14. Notwithstanding the advent of the water tube boiler, which will be mentioned further on, and its practical preëmption of naval practice, the cylindrical boiler still remains the favorite for the merchant service and has been used for pressures as high as 220 pounds, even in the largest sizes on such vessels as the "Kaiser Wilhelm." The highest recorded pressure is 255 pounds on the "Inchdune."

THE COMPOUND ENGINE.

15. From a very early period steam has been used expansively in marine engines, and indeed sometimes to a ridiculous extent. Some engineers as late as the Civil War hardly seemed to realize that there was any limit to expansion, although Isherwood's famous experiments on the "Michigan" in 1861 had demonstrated conclusively that, with low pressures, only a very moderate expansion is permissible, beyond which any further expansion is attended by an economic loss. As pressures increased it was natural and correct that a higher range of expansion should be used, and this made practicable the compound engine, where the expansion occurs in two stages, the high pressure steam from the boiler being limited to a small cylinder from which, in turn, the steam of low pressure is exhausted to a large cylinder. As you already know, the compound engine was invented almost as early as Watt's separate condenser, Hornblower's patent dating back to 1771, and Wolff's patent for a two-cylinder engine dating back to 1804. With the low pressures prevalent at that time the compound engine was actually at a disadvantage compared with the simple one. When pressures had gotten up to about 60 pounds, however, the compound engine began to assert itself, the pioneer in that respect being John Elder, of the firm of Randolph & Elder, which is now known as the Fairfield Engine Works. It is interesting to note that the Allan Line of steamers, which is now the pioneer in introducing the steam turbine for an ocean-going steamer, made the last scientific stand against the compound engine going so far as to take duplicate vessels and engine, one with compound and the other with simple engines of the same power. The actual experience with these two vessels where the simple engine with the high ratio of expansion was constantly in trouble from breaking down, was a convincing proof that high ratios of expansion in a single cylinder was impracticable.

16. With the improved workmanship which had come by this time and with the improvement in materials, to which we shall refer in a moment, which came later, the compound engine advanced to a high state of perfection and for large powers the three-cylinder type, with one high pressure and two low pressure cylinders, became a favorite for all large vessels These engines were probably as fine specimen of marine engine designing as have ever been seen, and included some exceedingly ingenious valve gears designed to secure variable expansion and an equalization of work among the various cylinders. As we shall see later, the further advance relegated these beautiful mechanisms to the engineering museum.

THE ADVENT OF MILD STEEL.

17. It is probably difficult for the young men in our technical schools of to-day who are familiar almost entirely with mild steel and very little with wrought iron, to realize what a change came in engineering when the production of mild steel became a commercially reliable matter. When we look back at the way in which some of the vital elements of a big marine engine was made, we are almost inclined to wonder that the material was reliable at all. The difference between a large wrought iron shaft such as old Hughey Dougherty used to make at the Morgan Iron Works, and one of the mild

steel shafts made at Bethlehem, is as great as could be imagined. Nearly the same is true of boiler plates. The young engineer of to-day would hardly know what was meant by a lamination or a "cold shut." The very method of manufacture made it necessary to use a large factor of safety in designing, with the result that the working stresses permissible were very low and the weight of machinery inordinately high. With the advent of mild steel and the introduction of careful and systematic testing, the designer had a material on which he could place absolute reliance so that the factor of safety could be greatly reduced. As a matter of fact the factor of safety has been reduced from 8 or 10 to 5, and sometimes as low as 4.5.

18. In looking back over my own experience, I do not see how we could possibly have built engines of the size and power now common with wrought iron for piston and connecting rods and shafting, and it is, of course, absolutely certain that we could not have built cylindrical boilers of to-day. The change began in the later 70's and had become almost complete by the middle of the 80's.

19. We must not fail to notice in the change to steel the use of steel castings, which have displaced cast iron in many places with attendant great reduction in weight. The first use of steel castings was attended with considerable annoyance because it was unfortunately assumed, perhaps naturally, that, barring the much greater shrinkage, it could be treated very much the same as cast iron, and it was consequently asserted with confidence that anything which had been made in cast iron could be made in cast steel. That is doubtless true to-day, but it certainly was not true ten or fifteen years ago, as I know to my personal sorrow, because designs which would have been considered simple in cast iron had to be entirely changed to meet the conditions then existing for steel castings.

20. It may be well to mention in this connection that about the same time that steel came into use displacing wrought iron, white metal for bearings and the stronger bronzes also came into use, thus giving the designer much better materials to work with and again reducing weights.

21. We may also mention here the gradual displacement of copper for steam piping by steel pipes, owing to the fact that for the high pressures common at present copper pipes would have to be very thick, making it difficult to secure a sound joint, and also to the serious diminution of the strength of copper by the high temperature

FORCED DRAFT.

22. Forced draft dates back of course to Stevens' Rocket, and its first use for marine purposes was by Mr. Robert L. Stevens on the Hudson River steamers in our own country prior to the Civil War. During that war Mr. Isherwood built a number of gunboats which used forced draft, but it had fallen into disuse until about 1882 for naval vessels, when it was introduced into the English navy and still later was applied in the merchant service.

23. In naval machinery forced draft has been of the greatest possible importance, because it has reduced boiler weights probably almost one-half. In the navy the natural limitations as to space and weight prevent the use of forced draft with very much economy of fuel. It is obvious that if the rate of combustion is increased from 15 pounds of coal per square foot of grate to 40 pounds, there ought to be an attendant increase of heating surface. In the merchant service, or at least in certain classes of vessels in that service, it is possible to do this, and in one of my annual reports I made a comparison between the boilers of a merchant vessel called the "Iona" and those of the "Baltimore." In the "Iona" there were 75 feet of heating surface for 1 grate, while in the "Baltimore" the ratio was about 30 to 1; but had the "Baltimore's" boilers been designed with any such ratio, their weight would have been almost double the weight of all the machinery of that vessel as actually built.

24. Mr. James Howden has made a specialty of forced draft under economical conditions, heating the air before admission to the ash-pit; and his system is now in use on most of the large steamers, the aggregate horse-power running up, I believe, to over a million.

HIGH ENGINE SPEED.

25. About the same time as the reintroduction of forced draft in naval vessels, the improved materials and workmanship made it possible to get higher rotational speeds, and, as remarked earlier, the true conditions of propeller design being understood, there was a marked increase in the speed of rotation of the engines. Naval vessels, from the necessary limitation of keeping the vital parts of the machinery protected as far as possible, have always run faster than the engines of the merchant service, although this did not always mean that their piston speed was greater. The mistake is sometimes made of attributing lighter machinery to higher piston speeds, but unless this is accomplished by increasing the number of revolutions it will not produce that effect. In the early days 60 or 70 revolutions per minute for what was then considered a large engine of 4,000 or 5,000 horse-power, was about the limit, but in engines of as much as 8,000 horse-power for a single set one finds the revolutions to-day as high as 130. Of course it is not practicable to show to just what extent any one line of progress has reduced weights by comparing the machinery at periods wide apart, because the increase of steam pressure, increased rotational speeds, improved materials and better designing have all gone along together—but it is interesting to note that in the "Warrior" of 1861, with 22 pounds boiler pressure and 54 revolutions, the horse-power per ton of machinery was 6, while in the "Minneapolis" of 1891, with 165 pounds pressure and 133 revolutions, the horse-power per ton is 10.9. From a simple mechanical standpoint, contributing agencies to the high speeds are the much more perfect journals of the steel shafts and the superior white metals used for bearings, and the rigidity of the steel hull of the ship, as compared with the older conditions. The best makers now grind their bearings true to a mandrel which represents perfect alignment. In the old days all main shaft bearings were hollow for water circulation, which was generally needed, and there was usually provision for a spray of water on the crank pins. In the modern engines, which have been well built and are carefully adjusted, there is no necessity for water even at very high speeds under full power.

THE MULTIPLE EXPANSION ENGINE.

26. The change from the simple to the compound engine involved a certain amount of difficulty and opposition, but the lesson was then learned pretty thoroughly that the amount of expansion in a single cylinder was moderate. Consequently as steam pressure rose the leaders of the profession became convinced that to secure adequate economy a further stage of expansion was necessary, and this brought about the triple expansion engine, the credit for which is deservedly given to Dr. A. C. Kirk, of the firm of R. Napier & Sons, of Glasgow, who first successfully used the triple expansion engine on the steamer "Aberdeen." The adoption of the triple expansion engine was almost immediate, and, after the success of the "Aberdeen" was demonstrated, all new engines of any size were built on that principle. It seemed a logical extension of this idea that with still further increase of pressure there should be the quadruple expansion engine, and a number of these have been built; but the advantage as compared with the triple expansion engine up to the point beyond which pressures have thus far not gone, does not seem to be clearly demonstrated, and a great many designers are adhering to the triple expansion engine with four cylinders, one high, one intermediate and two low pressures.

WATER TUBE BOILERS

27. Like so many other details not only in marine engineering, but in other lines of work, features which are introduced in a practical way in recent times are found to have a comparatively ancient origin. This is true of the water tube boiler, which in its recent use dates

from about 1880. The excavations at Pompeii have shown small boilers almost identical in construction with some of the best of our water tube boilers, although they were doubtless only used for a circulation of hot water.

28. The object of the water tube boiler is to reduce weights, give greater safety against explosion, greater rapidity of raising steam, and an increase of economy in the generation of steam. The various makes of water tube boilers are too numerous to mention, but they divide themselves into two broad, general classes; those with straight tubes of large diameter, say four inches; and those with curved tubes of smaller diameter, from an inch to an inch and a half. Probably no single boiler possesses all the merits which a perfect water tube boiler should have, and in nearly every case the attempt to secure certain advantages brings attendant disadvantages, and vice versa. The large straight tube boilers are not so light as the ones with small tubes; and it is more difficult to secure adequate economy, which is dependent largely upon skilful baffling. They do not permit of such rapid raising of steam from cold water as the smaller tube boilers. Because, like the Scotch boiler, they carry a large reserve supply of water in the boiler after the manner of the Babcock & Wilcox boiler. On the other hand, they permit the replacement of a defective tube and of the cleaning of a tube much more readily than the tubes which are bent. Likewise it is only necessary to carry one size of spare tubes, while the bent tube boilers require several sizes and shapes.

29. As far as safety against explosion is concerned, there can be no doubt that there is less danger of an actual disaster affecting the whole ship—although the worst accident which we ever had with a boiler in my naval experience was in connection with a water tube boiler on a torpedo boat, where all the crew of a fire room were scalded to death. Nevertheless, the boiler itself did not explode and was quite easily repaired. On the other hand, a few years before this a locomotive boiler on a torpedo boat in Germany exploded through the collapse of the crown sheet due to low water, and not only killed all the people in the fire room, but tore up the decks and utterly ruined the boiler itself. In this connection it is a cause of sincere congratulation that since the explosion of the "Thunderer's" boilers in the English navy many years ago, there is, I believe, no record of the explosion of a large, well-built marine boiler. For naval purposes where weight is such a great consideration, the water tube boiler commended itself at once, and it has now become the established practice in all navies to use only water tube boilers in new ships. Our English friends had some trouble with the Belleville boiler, but this seems to have been due to some extent to lack of familiarity with it, and other legitimate reasons. In the merchant service where weight is not so precious, the water tube boiler has not thus far so thoroughly commended itself to designers; and, as remarked earlier, all of the latest large vessels are still using cylindrical boilers. Some of the reasons for the hesitation to adopt water tube boilers are that, of necessity, an installation of large power means a very large number of boilers, because the water tube boiler does not admit of single units of great power comparable with the large double-ended cylindrical boilers. This means an immensely greater complication in the way of piping, valves, fittings, feed pumps, etc. Moreover, owing to the small amount of contained water, which is very desirable in so far as weight is concerned, the water tube boiler is very sensitive as regards steam pressure and water level, requiring very much more care and attention than the cylindrical with its immense amount of contained water. It seems to me not impracticable that the able men who are engaged in the study of this question will finally succeed in developing a type of water tube boiler which will commend itself for use in the merchant service as well as in the navy. Some of the boilers fitted in the United States naval ships had but six minutes of water endurance after the pumps stopped working, while one of those, the Babcock & Wilcox, adapted to our naval use has as much at twenty-five minutes' endurance, which is a close approximation to the Scotch boiler.

AUXILIARIES.

30. In the early steamers almost the only independent steam auxiliary was a single pump which could be used for feeding the boilers while under banked fires or with the engine stopped, and for pumping the bilge. The other pumps were attached to the main engine. Such things as steam capstans, and winches, steam steering gear, distilling apparatus, evaporators, forced draft blowers and electric light engines were not dreamed of. As time went on and the size of vessels increased, steam capstans and winches and steam steering engines came in. Then it began to be found desirable, particularly for naval engines, to remove all the pumps from the main engine, leaving it nothing to do but turn the propeller, and this brought about independent air and circulating pumps and feed pumps. Further progress introduced the distiller and evaporator, the forced draft blowers and the electric light engine

31. Most of these auxiliaries, from the nature of the case, are driven by simple engines, the pumps usually being for very slow piston speed and without expansion. The result is that the economy of these auxiliaries is naturally very low, and for some years past it has been the aim of designers to do something to either make the auxiliaries themselves more economical or at least utilize the heat in the exhaust steam. In some cases it has been arranged to have the auxiliaries in the engine room take their steam from the first receiver and exhaust into the second, thus, in effect, making all their cylinders part of the intermediate cylinder, as far as the steam cycle is concerned, with its attendant economy. I remember one of my former associates telling of how he had actually tried this on his ship with a saving of some six tons of coal a day, for machinery which was then working at about 8,000 horsepower. In the case of the feed pumps, arrangements have been made to turn the exhaust steam into the suction pipe, thereby having this heat carried back into the boiler, but this has not been done to any very great extent. Another plan has been to turn the exhaust from all the auxiliaries into a feed water heater through which the main feed to the boilers would go, and this has been attended by very good results.

32. The question has been raised repeatedly by electrical engineers that it would be a good plan to drive the auxiliaries by electric motors, on account of their very high efficiency even at fractional loads. For the engine room auxiliaries and the boiler feed pumps it seems to me that this is unreasonable, for it means increased complication and certainly an increase in weight; and it has never been shown to my satisfaction that there would be any material increase in economy, owing to the fact that the dynamos as usually supplied on board ship are not large enough to have very economical engines, and from the fact that there are so many machines each with an efficiency less than unity in the circuit between the boiler and the final pump.

33. There are some auxiliaries on board ship, however, where it would seem motors could be used to advantage, notably for driving the forced draft blowers. From the necessities of the case they are usually stowed in hot and rather inaccessible places and it is difficult to keep the engines in good adjustment. It hardly seems to me, however, that direct current motors are well adapted to this service, as they would have to be of the enclosed or dust-proof type, which reduces their heat-carrying capacity, and as they have to go in places where the heat is already very great. If alternating current machinery were installed, it seems to me that the induction motor with its extreme simplicity and ability to withstand very hard usage would be especially adapted to this work.

34. It is doubtless known to all of you that in the modern ships the turret turning is done by electric motors. While this is an engineering matter, on board ship it comes within the purview of the

ordnance officer, and therefore I have not dwelt upon it. The anchor capstan and steering engine should be electrically driven, but because of peculiar conditions existing in the navy this has not been done.

THE STEAM TURBINE.

35. The latest note of progress in marine engineering seems to be the advent of the steam turbine, which for some purposes has passed the experimental stage, and has given great satisfaction. As already mentioned, a number of small vessels of the torpedo boat class have been built with steam turbines, and this has been followed up by their use in a number of excursion steamers and cross channel steamers between England and France and England and Ireland. The Allan line of steamers have also decided to equip a large new steamer with turbines, and, as we all know from the technical press, the Cunard Company have had a very able committee considering the question of their adoption for the two new flyers which that company is to build—as a result of which they have decided to use turbines in them.

36. The turbine has had an extended use in the last four or five years on shore for driving electric generators, and this has been so satisfactory that the pioneer work of the Westinghouse Company in this country has been followed by the General Electric Company, the Allis-Chalmers Company and a number of other engine builders, who seem to have reached the conclusion that for large powers at least the turbine is quite sure to supersede the reciprocating engine.

37. For constant speed at its rated load the turbine is very economical, comparing in this respect with the most economical reciprocating engines, and its economy does not fall off so rapidly with the decrease of load at constant speed as is the case with the reciprocating engine.

38. For marine purposes two questions have bothered those who were seeking information, one, the question of reversal, and the other, that of economy, where not only the power but the speed is reduced, as is, of course, necessary in the propulsion of vessels. With respect to the former, different methods have been suggested and tried in different cases. In some instances Mr. Parsons has used separate reciprocating engines which are normally idle. In others, and this appears to be in his latest practice, there are reversing turbines inside the exhaust passage of the ahead turbines, so that while the ship is going ahead these turbines revolve idly, after the manner of a fly-wheel, in an excellent vacuum. When the ship is to be reversed, steam is admitted direct to these turbines and secures the reversal.

39. With respect to economy, there is, of course, a marked falling off from that at full power, but not more so than in the case of reciprocating engines. It seems hopeless to expect that any machinery will work with the same economy at one-tenth power than it does at full power, and it would be unreasonable to expect the turbine to do this when the reciprocating engine does not.

40. The advantages of the turbine are, the entire absence of reciprocating parts, of bearings to be adjusted and the extreme simplicity of operation, together with the great reduction in weight due to the very high speed. Added to this is the entire freedom from danger due to priming of the boilers, the only result being a slowing down of the turbine and reduction of economy. There is also freedom from lubricating oil getting into the boilers.

41. Propeller design with the turbine is more difficult than with the reciprocating engine, because the conditions are entirely different from those which have hitherto obtained, and there is so little experience with propellers running at speeds of over 1,000 revolutions a minute in the case of small ships, or at 500 to 750 in the case of large ones. The Cunarders' propellers, it is understood, are to be limited to 180 revolutions per minute. For it must be remarked that in spite of the fact that we now have very clear and logical rules for the design of propellers under existing circumstances logically worked out, nevertheless these rules and formulæ came after the experience rather than before. This matter, however, can undoubtedly be cared for, and when more experience has been gained the design of propellers will be as easy for existing conditions.

42. For naval vessels from a military standpoint the turbine has a great deal to commend it, inasmuch as the machinery will stow very well in the ship and be out of harm's way, the propellers are so small and so well immersed that there is no chance for racing even in the heaviest seas, and all questions of vibration are eliminated. As already mentioned, the saving in weight is also a matter of decided value, if it can be done.

CONCLUSION.

43. We have now considered very hastily the important epochs in the history of marine engineering, and it will be seen that they indicate steady progress along certain lines. There has been a steady increase of steam pressure, increase of rotational speed and diminution of weight, accompanied by increased economy in the making and using of steam. If time had permitted it would have been very interesting to compare such a vessel as the "Great Eastern," which for so long a time was the criterion of immense size, with the "Celtic" and "Cedric," which are even larger than she was. The "Great Eastern" was simply about thirty years ahead of her time. She was a remarkable production and a great credit to her designers in every way, but she was a commercial failure, because marine engine manufacture had not yet reached the point where such a huge vessel could be operated profitably. She carried more than twice as much coal as one of these present day vessels, which easily makes the same speed with machinery weighing probably not more than one-third of what hers did

44. The economy of the marine engine, or of the turbine if it displaces the engine, has reached a point which does not leave much room for improvement in materials and workmanship. Yet it will be unreasonable to believe that we have reached finality, for it is likely that there have been numerous periods in the past when the designers of those days could not see what the next step in advance would be, and so far as their knowledge went their design was nearly perfect. Of course there was certainly plenty of margin for increased economy with them from which we are barred, but I have no doubt that if I could live to be as old as Mr. Haswell I should see some decided improvements in the course of the next thirty years.

The minimum distance from the center of any rivet hole to a sheared edge ought not be less than 1½ in. for ⅞-in. rivets, 1¼ in. for ¾-in. rivets, 1⅛ in. for ⅝-in. rivets and 1 in. for ½-in. rivets, and to the rolled edge, 1¼, 1⅛, 1 and ⅞ in., respectively; the maximum distance from any edge should be eight times the thickness of the plate.

At least one tensile and one bending test ought to be made from each melt of steel as rolled. In case steel differing ⅜ in. and more in thickness is rolled from one melt, a test should be made from the thickest and thinnest material rolled.

Columns which are strained in tension at their base should be anchored to the foundations by bolts long enough to engage a mass of masonry, the weight of which should be at least one and one-half times the tensile strain in the anchor.

Steel angles ¾ in. and less in thickness should open flat, and angles ½ in. and less in thickness should bend shut, cold, under blows of a hammer, without sign of fracture.

Structural steel, which has been partially heated, should be properly annealed, and all steel castings should be annealed, also.

Rivet steel, when nicked and bent around a bar of the same diameter as the rivet rod, should give a gradual break and a fine, silky uniform fracture.

New Designs of Gas Producers.

We illustrate herewith two recent designs of gas producers. The one shown in Fig. 1, the invention of Mr. William Towns, of 100, Claremont Road, Liverpool, has been designed for producing combustible gas by burning bituminous coal with an insufficient supply of air, and the object is to provide means whereby the crude gases thus produced will be enriched and purified from tar, soot, etc. The invention consists essentially in passing the crude gases through incandescent non-bituminous carbonaceous material, such as coke, which when exhausted for purification purposes may be pushed into the gas producer as a part of the fuel supply. 1 is a gas producer of any usual kind for bituminous materials having the gas outlet 2 at the upper side, 3 blower

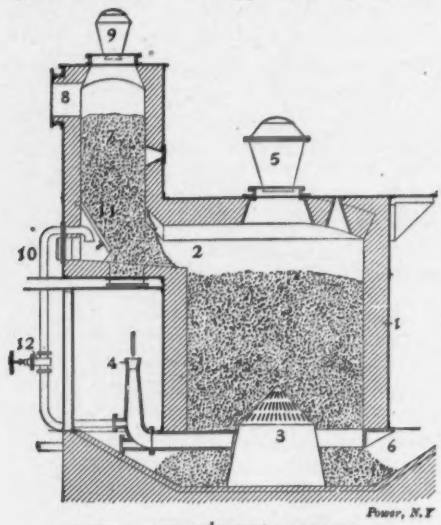


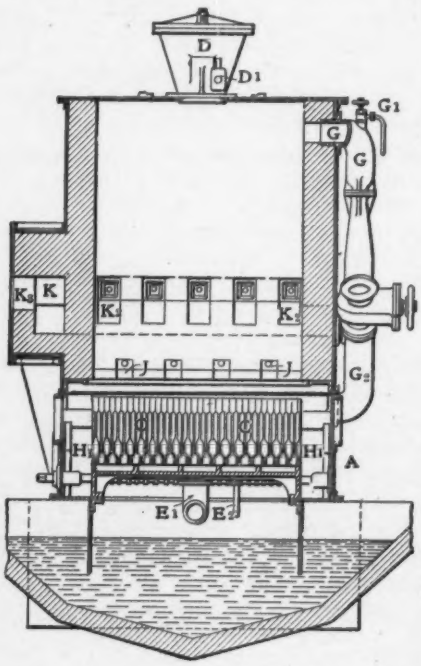
FIG. 1. TOWN'S GAS PRODUCER.

for supplying air or air and steam to the bottom of the fuel in the producer, 4 air injector, 5 fuel supply hopper, 6 well for ashes, 7 is a chamber lined with refractory material and disposed laterally adjacent to the producer 1, the gas outlet 2 of which leads into the lower side of the chamber 7. 8 is the gas outlet from the upper part of the chamber 7. The chamber 7 is nearly filled, and maintained so, with non-bituminous carbonaceous material by means of the charging hopper 9. 10 is a pipe for admitting air from the injector 4 to the lower part of the chamber 7, but so as not to come in contact with the gas coming from the outlet 2, thus preventing combustion of such gas; and 11 are grate bars for partly supporting the carbonaceous material and allowing better distribution of the air; 12 is a valve for regulating the air supply.

In operation the non-bituminous carbonaceous material in the chamber 7 is ignited and raised to incandescense by air blown in through the pipe 10; the crude gases from the producer 1 pass through the outlet 2 up the column of incandescent material and out through the outlet 8; any CO^2 present being thereby decomposed into Co, and any tarry vapors, soot, etc., being also converted into permanent gases, or intercepted by the carbonaceous material, and thereby in time carried down through the producer 1 into the ash well 6. In addition to the direct purification and enrichment, the above-described arrangements allow of the producer 1 being worked at a higher temperature than usual, whereby less tarry vapors and soot are produced than hitherto has been the case. It is necessary that the air supply to the chamber 7 be carefully regulated, so as to maintain the carbonaceous material therein at incandescence without admitting air sufficient to convert any of the final gases into Co_2. It is also necessary that such air be admitted to come in contact with the hot coke or other carbonaceous substance only, and not with the crude gas from the producer. The air is therefore admitted into the column of coke by an inlet at some distance from that of the entrance of the gas from the producer into the column of coke.

Figs. 2 and 3 show an arrangement of producer designed and patented by Mr. E. Hall-Brown, of 140, Hyndland Road, Kelvinside, Glasgow, of the type in which the unfixed hydrocarbon gases collected in the upper part of the producer are led downwards and made to pass through the hotter regions of the fuel bed, so that they may become fixed. The producer is built up, as usual, of iron plates A lined with firebrick. The grate is inclined, as shown in Fig. 3. The firebars C are capable of being rocked, so as to prevent clogging and assist in the descent of the ashes. The producer is also provided with the usual feeding hopper D and charging device D_1; and air, or air and steam, to support combustion is supplied below the grate by pipes E_1 E_2.

A pipe G fitted with a steam or air jet nozzle G_1 extends from the interior of the producer at its upper portion to branch pipes G_2 G_3, fitted with stop valves, and leading to casings H_1 H_2 extending along two sides of the producer at about the grate level. The flow of steam or air from the jet nozzle G_1 draws off the volatile hydrocarbon gases from the upper portion of the producer, and these gases pass by the pipes G G_2 G_3 to the casings H_1 H_2. From the casings a series of passages J lead the gases back into the producer. The series of passages are arranged at various levels so that the gases may be admitted either at the level of, or above, or below the grate. Chambers K are formed in three of the walls of the producer, the chambers in two opposite side walls communicating by passage K_2 with the interior of the producer at a level suitable for the final discharge of the fixed gases which pass off by an opening K_3. As there is a considerable number of the passages J and K_2 for ingress of the unfixed and egress of the fixed gases, strong local action is prevented and the unfixed gases enter and the fixed gases leave the fuel bed practically equally throughout and in all directions—*The Mechanical Engineer.*



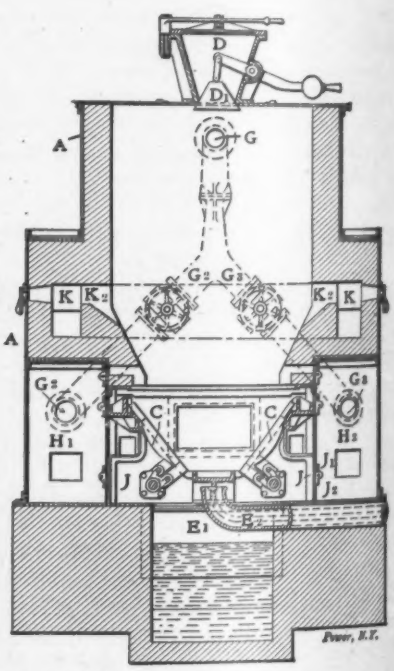


FIG. 2. HALL-BROWN'S GAS PRODUCER. FIG 3.

No formula has been suggested for determining the bearing power of piles driven by a steam hammer. We are not prepared to suggest any formula for this class of work, but call attention to the desirability of one.

If some specification for pressure upon foundations is desired, the depth of the foundation should enter as a factor. The buoyancy of the soil is a function of the depth of the displacement of the building or other structure.

Echoes from the Oil Country—Not Willing to take Advantage of All Opportunities.

Do you mind how you used to feel when you were going to school and something happened, and you could see by the way the teacher handled the rod (this was before the days of the fads in the schools) that something else was going to happen as soon as he got his eyes, and his hands, on the right boy? Didn't you wish that the right boy would step up and fill the place that was waiting for him, and not keep that awful and solemn feeling going so long? Sometimes it would happen that the right boy would, for some mysterious reason, be absent, and then the master would regretfully lay the rod away unused and speak of the opportunities which, once gone, never return, until you knew that it was awfully wrong to run and jump on another fellow's back and try to roll him in the dust, while you threw his hat into a tree. Do you mind the story of the boy who took advantage of his opportunities and applied himself, and was trying to be someone? He didn't waste his time like some boys that could be mentioned, and was studying Latin at 3 years of age, was writing poetry at 6, had almost had time to forget mathematics at 10, and—well if he had kept on living there is no telling what he might have become by this time.

Don't you mind how the preacher and the Sunday school teacher used to tell you about how wasted time was gone forever, and how the foreman in the shop where you went to learn the trade used to give you a little along that line when he found your head was without many mechanical ideas, and how the mechanical papers used to keep you prodded up for fear that you might forget it as you got older?

When you have been taking a day off going fishing or sitting watching the "kids" tearing around of an evening, don't you feel a little guilty? Here you have been spending your time eating and sleeping and enjoying yourself out of working hours, when you might have been improving yourself.

I will own up that I belong to the same culpable class as you, and it is because of the fellow-feeling that I have for you that I wish to warn you. I have tried to make excuses for myself when reading the articles by Mr. Carnegie and others who have worked up, to the effect that I have done pretty well *for me*, and have given them credit for qualities (or lack of qualities which made them different from me. When the fellow who had the half barrel of oil wrote and tried to save me money, I considered that he had mistaken me for the other fellow. I have had to acknowledge that I did not have the courage of a "Napoleon of finance" when solicitous friends have offered me stock in gold mines, and silver mines, and orange groves, and prospective oil wells, and often too I did not have the price that even a "nominal value" called for. I excused myself with the thought that if I was born without courage I was sorry, but it was not my fault. The philanthropist who gives away gold watches with a small allowance of belt grease has done his best to elevate me, but I have felt that it was not becoming for a humble and ignorant machinist to carry a gold watch in his pocket, and yet not have even a speaking acquaintance with the calculus. In fact I have made all sorts of excuses for going off fishing and hunting, and boating and wheeling, and going to bed early and getting up late, and doing the things which I like to do. I do not know that I have been quite as bad as E. R. Plaisted shows himself to be in his article at page 384. He seems to think that he would rather be "oslerized" than to improve all of his spare time. I wish that he would come over into this section of the country and loaf around with me while we invent some sure exterminator for these people who are so much bent on improving some of us people who cannot appreciate their efforts.

I have never as yet had the pleasure of a personal meeting with Mr. Plaisted, but I believe that we could be friends, for I think he has some of the ways that there are lots of people lying awake nights aching to change just as I find that I have. Forewarned is said to be forearmed, and I will tell him and some more of my friends (I hope I may still have a few left) my latest trouble.

Before me is a letter. It is from a dispensary of wisdom that is connected with an "Institute of Technology." It is a personal letter to me, and it gives me an awful picture of my shortcomings. At a good deal of expense they have tried gently to urge and direct me into the right way, so the letter informs me, having found out that I am not occupying the position which I should in the world. Boys, who knows but that you may be shadowed as you move about, and all that wasted time you are using feeling good kept track of. The offer is made that for the small sum of seven cents a day they will rescue me from myself, and when I have gained the place to which my natural ability entitles me, and have accumulated wealth beyond the possibility of my present position, I can make such further payment as may be right.

To make this matter more humiliating to me it slipped out in this letter that a "prominent manufacturer" right here close by me has been looking for a man such as I would be with a little polishing, and looking in vain because I did not hustle and get rescued a year, or thereabouts, ago, when I was offered, if my memory serves me rightly, a free scholarship which some philanthropist had placed at their disposal for my benefit. There is a friendly hint that someone is getting up some sort of a machine that will take my work in the building of cornshellers away from me if I do not take this course, and a beautiful certificate which it is a shame not to use is sent along.

If I could go without sleeping, and didn't need to spend any time eating or taking exercise, and was so young that I didn't have any idea of what a very ordinary fellow's capacity is, there might yet be hope for me, but as it is I fear the case is hopeless.

Wishing to show my appreciation of the efforts put forth I will say that the writer of that letter should be working for the publication which has several times been mentioned by the AMERICAN MACHINIST, and which has such a faculty for finding out all the good points of the product of a firm by a special (?) staff of correspondents.

I am sorry that an intimate acquaintance with myself does not lead me to have the faith in myself that the writer shows. I am afraid that one half hour a day faithfully applied for a year, although that means eighteen and a quarter days of ten hours, if I should work every day, including Sundays and all holidays, would not turn a natural mudsill into a general manager.

More sorry than I am for myself and my fellow ignoramuses (or should it be ignorami?) am I for the institution of learning that has to descend to the practices of the "bunco steerer," the "gold-brick" man, and the "get-rich-quick" concerns to save us from ourselves.

W. OSBORNE.

Here is an example of a combination which has been proposed by some engineers: The Philadelphia Rapid Transit Company has installed in its new power station at 13 Vernon St., an 800-kw. Curtis steam turbine, operated by exhaust steam from the Corliss engines. The station had been running non-condensing; the exhaust from the turbine now is condensed by the aid of an Alberger condenser and cooling tower. The steam enters the turbine at about 1 pound (gage) and the vacuum averages 28 inches. The turbine gives 1000 h.p. from the exhaust of 2500 engine h.p. It would be strange if the turbine should turn out to be an auxiliary of the large reciprocating engine.

A unique bid for sewer construction is said to have been received by the City Council of Douglas, Alaska. According to the Douglas *News* it read verbatim as follows: "The cost of metiril we no. There is stumps in the way we no. And there is bolders in the way we don't no. There is quick sand that will run we no. There is hard pan that is hard I no. Any one that will take it fer less than 35 cts. a foot will go in the hole I no."

Studies in Inventive Problems—XVII.

PROPOSED BY LEICESTER ALLEN AND SOLVED BY VARIOUS READERS.

Some of the solutions to these problems which come to hand are evidently from persons who did not see the first article of the series, which contained necessary rules for the form in which solutions should be presented. I think, therefore, that, as the neglect to strictly observe these rules is causing some of the solutions to be thrown out, it will be of service to the newer readers of the AMERICAN MACHINIST, to those who wish to contribute solutions, and to myself, to reprint the rules referred to, as they appeared at page 1621, Vol. 27, Part 2 (1904), of the AMERICAN MACHINIST.

Formal Rules for Presenting Solutions.

The sketches or drawings should be as neatly executed as possible, but no sketch which is intelligible will be rejected solely on account of inartistic finish, provided the written matter explaining it is found sufficient to clearly elucidate the solution.

All complete solutions will be published. In writing, use one side only of the paper, and, if possible, use paper of commercial letter size.

No one need hesitate to write on account of inexperience. If the meaning is plain, the text will be carefully edited and made entirely presentable in print.

All will be treated alike. If two or more solutions are found to be substantially similar, the sketch or drawing best illustrating the description will be selected, but credit for the solution will be given to each of the solvers.

Free criticism of the problems will be permitted, but it must be done courteously. Any attempt at sarcasm will pass into the waste-basket. A good solution from a youth will be valued as highly as though it came from a mature expert. Fair field and no favor will be the rule.

Any name which may be chosen may be affixed to a printed solution, but the real name and post-office address must be signed to each contribution, as it often happened in the progress of the first series of problems, that personal correspondence became desirable. Both the manuscripts and the drawings should be thus signed.

The drawings should, if possible, be inclosed in the same envelope with the manuscript description.

The neglect to sign either the manuscript description or the drawing, and in some cases both, the contributor sending the drawing and the description, accompanied by a letter, which last only has the proper signature, is of most frequent occurrence and often causes annoyance. These solutions do not always reach me singly, but are forwarded to my address in packages, and the neglect to *sign each paper in full* gives me trouble in mating the separated pairs, sometimes even leading to the consignment of unsigned papers (evidently containing acceptable solutions) to the waste-basket. This I always do with regret. A description or drawing that is worth preparing, is surely worth signing. The signature should comprise date, full name and residential address. A fictitious name, if the correct name is also given, will, on request, be substituted in printing any solution.

Harold Smith, of Bradford, York, England, responds to my request for criticism, as follows:

"A few ideas have struck me in reading through the solutions which have appeared lately.

"I think that your solution of Problem V is a most ingenious one, and beautifully simple. It puts fancy gears completely in the shade. I notice F. W. Slade (Page 149. Vol. 29) is well on the right track with his solution. He left the joint in the vertical reciprocating shaft, although it is useless in his arrangement.

"In Mr. Whaley's solution of Problem VII (Page 152, Vol. 29) I see no provision for feeding the cutter into the work to start cutting. It would be rather difficult to arrange a feed for the cutter as it is shown. I see no reason for driving the apparatus which carries the cutter by power, seeing that it will probably have to stop after each cut to allow the work to be changed.

"If I am not mistaken, gearing is avoided as much as possible in practice for driving wood-working cutters at high speed. I see that Mr. Whaley drives his cutter through a small pulley by *five* gear wheels. If no other system is possible with his arrangement, why not arrange the gearing to give the speed and use a larger pulley, running at a reasonable speed? Also with regard to the spiral forming arrangement, this involves the use of a toothed segment, a spur gear, a large bevel toothed ring and a bevel pinion; and if different spirals are required, three or four more gear wheels. This does not strike one as being a very cheap arrangement. Mr. Whaley has evidently taken great pains with his solution, and his drawings and descriptions are very easy to follow. No doubt the arrangement would work satisfactorily if provided with a proper feed for the cutter.

"John Gargan's arrangement looks very

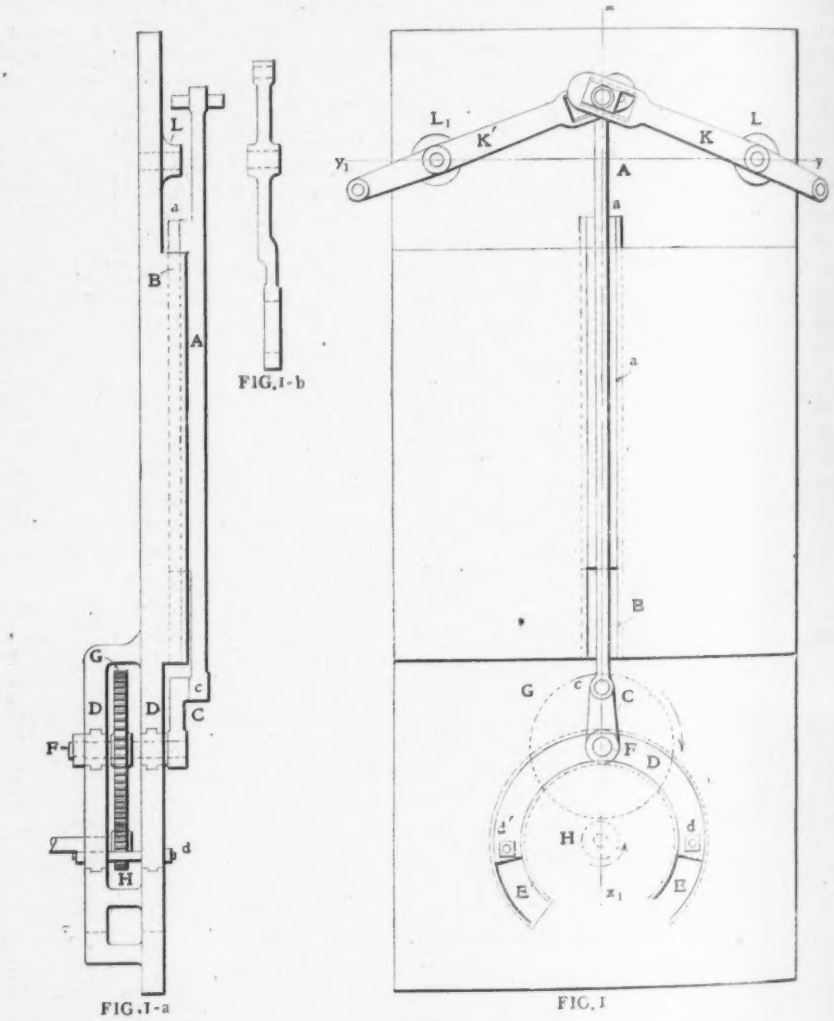


FIG. 1

SOLUTION NO. 3 TO PROBLEM VI.

well and his drawing is splendidly executed, but I do not think it would work well in practice even if it were not too expensive a machine for the object to be attained. The first great objection which I see to the design is the disposal of chips. It is quite evident that with a board laid flat on the table there is only one way for the chips to escape, and that is down the slot into the machine. This being the case, it would soon be in a similar condition to a man with a stomach full of chips. Presuming the difficulty could be overcome, then there is the question of lubrication. Inside the machine there are eight or nine bearings, one long screw and nut, and a slide arrangement, which all require periodical lubrication. This might be managed through the top and sides of the machine; but it would be difficult, without taking the top off, and, moreover, it would require doing very often considering the amount of dust or dirt flying about.

"The next point is the work table. This is an expensive part of the machine and a different one would be required for each size of spiral. The drive for the cutter has the same fault as Mr. Wright's, only in a greater degree. The power is transmitted through six bevel and two spur gears, involving the use of seven or eight bearings altogether. The spiral-forming mechanism is very much like Mr. Whaley's, only inverted and more complicated. It necessitates the use of three spur gears, a worm, worm wheel, bevel pinion, bevel-

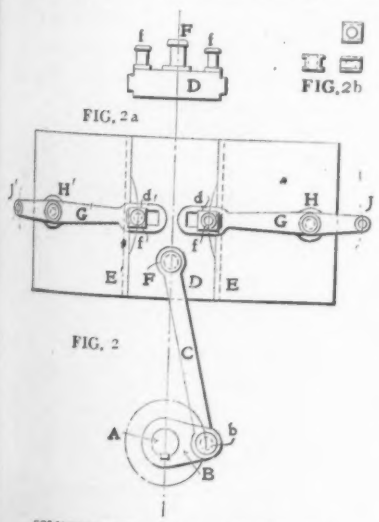


FIG. 2a FIG. 2b

FIG. 2

SOLUTION NO. 4 TO PROBLEM VI.

toothed circular racks and screw with nut. To obtain different sizes of spirals, the screw and nut would have to be changed, or a gear arrangement inserted between the pinion marked *Z* and the screw.

"I think it is desirable to obtain a result with the smallest number of parts possible, and to remember the relative cost of making different kinds of mechanism."

Harold Smith's remarks meet my expressed wish for criticism of these problems. The problems actually demand nothing more than the working out of possible ways to effect specified results. Practical designing of course brings in many collateral questions, cheapness of construction, durability in use, which includes proper lubrication, and convenience in applying lubricants, simplicity of operation, etc., etc. But, of course, it still remains, in original design, that when a result to be obtained is presented with no means for obtaining it known to the designer, the invention of some way to accomplish the required result takes precedence of all others, the points enumerated in Mr. Smith's criticism being collateral and subsidiary, to be afterward met as fully as the nature of the mechanism will permit. In this series of articles it is the power of grappling with the underlying, primary features of the problems presented which it is desired to cultivate, and which will hold first place during the progress of the series.

Resuming now our consideration of solutions of Problem VI, I print the following extract from a letter as a sample of communications (more especially from younger contributors) which I not unfrequently receive. I present the solution to which it refers in this number. The letter is from M. A. Wolfard, of Laramie, Wyoming.

"After studying Mr. Smith's solution, described at page 150, current volume, it seems to me that the essential principles applied are the same as in my own, which, however, differs in the details of the crosshead. Perhaps my sketch was somewhat clumsy and the manner of presentation not exactly in accordance with modern practice, but I am at a loss to know just where I failed. I am only a young man (not yet 27); about two years ago received the B. S. degree from the State University of Wyoming; am at present assistant night engineer at the 'Union Pacific Wood Preserving Works' here, and would, indeed, be grateful to you if you would point out my error or errors in this, my first attempt."

Mr. Wolfard has not yet learned by experience the delays in publishing contributions necessarily imposed in the publication of such a technical weekly paper as is the AMERICAN MACHINIST. In every department of such a publication matter accumulates beyond the belief of those not initiated. The receipt of these solutions is first acknowledged at the office of the AMERICAN MACHINIST at the time they are received. They are then placed in my hands, where they remain till they either are prepared for the press, or are decided to be imperfect. In either case, the author of any solution will ascertain its fate, in some succeeding number of the series, but often he must wait for the announcement so long that those inexperienced infer that their solutions have not received due attention. It is an imperative duty imposed upon me by the editorial management to give due attention to all solutions presented in proper form; a duty scrupulously performed by me in every case.

PROBLEM VI, SOLUTION NO. 3, FIGS. 1 AND 1*a*. J. MELANCON, AMITE, LA.

This solution comprises an unnecessary complication of parts to effect the required result:

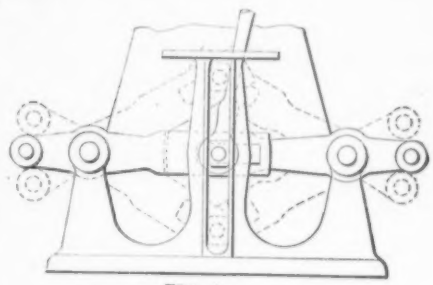


FIG. 3

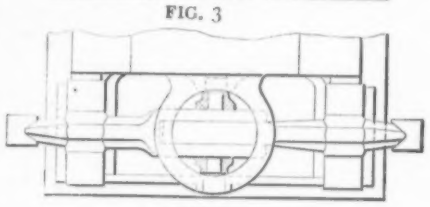


FIG. 3a

SOLUTION NO. 5 TO PROBLEM VI.

"Fig. 1 shows plan; Fig. 1*a*, a side elevation, with levers *K* and *K'* removed, and Fig. 1*b* shows a side elevation of one of the levers. In order that the levers may be for all points of the stroke at an equal angle to the line along which power is applied, or, in other words, in order that the angles formed between the line of application of power *x*-*x'* and the center lines of the levers may be equal to each other at all points, the force-applying end of the connecting rod *A* is made to move in the straight line *x*-*x'* by the block *a*, rigidly connected to the rod and guided in its movement by the guideway *B*. Crank *C*, which is connected to one end of *A*, is keyed to a short vertical shaft *F*, having its bearings in two segmental blocks *D* and *D'*, which are held together and made to move as one by the bolts *d* and *d'*, backward and forward in the segmental guideway *E*-*E'*. On the vertical shaft *F* is keyed a gear *G* (pitch line of which is indicated by dotted line in plan), which is driven by pinion *H*. Through the other end of *A* is forced a pin which projects on both sides and engages with the sliding blocks in the slotted ends of the levers *K* and *K'*, which oscillate about the fulcrums *L* and *L'*.

"Suppose the mechanism to be started from the position shown in Fig. 1. Pinion *H*, turning in the direction indicated by the arrow and the teeth engaging with those of *G*, cause it to revolve in the direction of the arrow; but as the end of *A* (and consequently joint *c*) can only move along the line *x*-*x'*, and as the shaft *F* is free to move around the segmental slot *E*-*E'*; and as joint *c* moves toward *H* shaft *F* is forced to move around the slot

in the direction of E' until that point of the stroke is reached at which the center line of the crank is at right angles to the center line of motion x-x'; after this point is passed, the effect upon F of continued rotation of G will be to pull it back to line x-x', until, at the end of stroke, F will occupy the same position as in Fig. 2; but the crank pin will be on the opposite side to that shown, or nearest to H. On the return stroke the action will be similar, except that the movement of F will be in the direction of E."

While conceding that this arrangement would secure the required movement of the levers K-K', I do not see, in view of the very much simpler and equally effective solution which follows, why Mr. Melancon could think it necessary to resort to all this complication.

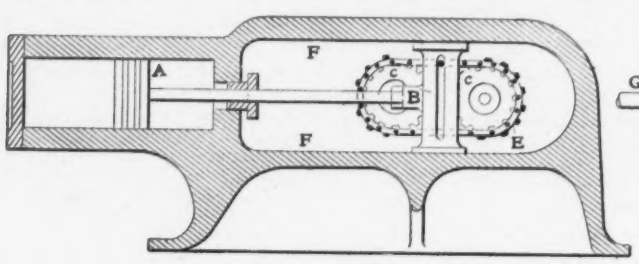


FIG. 4

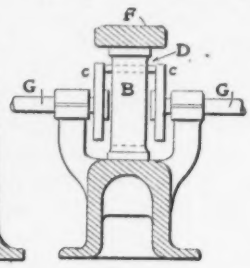


FIG. 4a

SOLUTION NO. 2 TO PROBLEM VIII.

PROBLEM VII, SOLUTION NO. 4, FIGS. 2, 2a AND 2b. J. MELANCON, AMITE, LA.

"Fig. 2 represents a plan of the assembled mechanism, Fig. 2a is an end view of the main sliding block, and Fig. 2b gives three views of the small sliding blocks d or d'.

"The mechanism is driven by shaft A and crank B through connecting rod C which transforms the rotary motion of crank pin b into the reciprocating motion which it imparts to the main sliding block D. D is guided in its straight line motion by the guides E and E'. From block D project three pins, the larger of which, F, takes the end of connecting rod C. The two smaller pins, f and f', are each provided with a sliding block d and d' (which are shown in detail in Fig. 2b). These sliding blocks are easy fits for the pins and slide in the slotted ends of levers G and G', causing them to oscillate through arcs of circles as indicated by the dotted lines. Levers G and G' have their fulcrums at H and H' and the resistances are connected to J and J'." The movement is obvious, and requires no further description.

PROBLEM VI, SOLUTION NO. 5, FIGS. 3 AND 3a. M. R. WOLFARD, LARAMIE, WYOMING.

The description is given as follows, by Mr. Wolfard:

"One arm is somewhat reduced in width and works between forks on the other, as shown in the plan. Both arms have longitudinal slots cut in them to receive sliding blocks. The pin through the head end of the pitman passes through the center of these blocks and transmits the power to the arms. The head of the pitman is also forked and fits against the outside of the forked arms. The pin extends on either side of the head and carries another sliding block on each end. These sliding blocks are similar in construction to the others, but are fitted between vertical guide bars, and thus compel the pitman head to travel in a perpendicular path. And now I believe by a close examination of the view in elevation, the motion will be thoroughly intelligible. The crank is not shown, but, as suggested, would be supported on the same base as the rest of the mechanism and may receive power from any available source; the only requirement being to revolve the crank shaft at the proper speed to suit the work. I have described the true symmetrical motion which I believe capable of a construction strong enough to meet any demand with the levers loaded equally or unequally, simultaneously or alternately. However, there is a limit to the speed; which if excessive would cause very rapid wear. For arcs of oscillation not greater than forty-five degrees and comparatively low speeds, it is my opinion that a slightly modified and much simplified construction would work very well. The gist of this construction consists in dispensing with the guide bars and also the slots in the forked arm, passing the 'pins' through a hole near the end of the forked arm and slotting the other arm so that the travel of the 'sliding block' may be twice what it was before. The path of the pitman head, instead of being perpendicular, would now be the arc of a circle whose radius would be the length of the forked arm and should be such that the pitman head travel, projected on a horizontal line, would be equal on either side of the perpendicular path. One sliding block would be used in this, as against five in the other construction; which suggests in a forcible manner the saving in both time and material when possible to use the simpler construction."

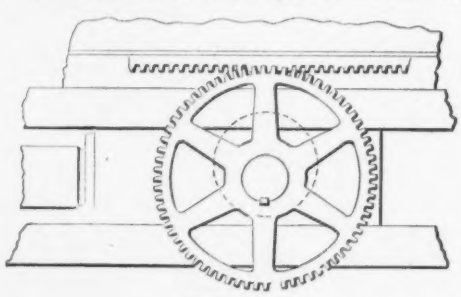


FIG. 5

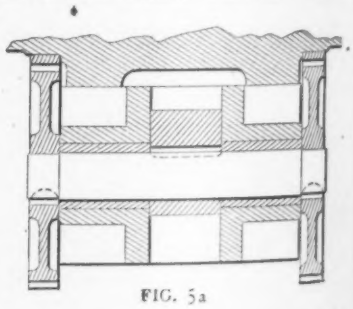


FIG. 5a

SOLUTION NO. 3 TO PROBLEM VIII.

PROBLEM VIII, SOLUTION NO. 2, HOMCO.

The gentleman who supplies this solution desires suppression of his real name and address for business reasons. As will be seen, he expresses a doubt, which I share, that it is an adequate solution of Problem VIII, but as he states that the movement, or something very similar, has been satisfactorily employed for changing a high rotary speed into a long reciprocating motion, it may contain a helpful hint and I give it place. I do not perceive that the required cut-off could be effected either with or without rock-levers, and lead, admission, exhaust and compression must also be considered. The following description accompanying the sketch is not sufficiently explicit:

"I have doubts that the sketch will fill the conditions, but will submit it from the fact that it has been employed for a similar purpose and will do well enough up to 2 or 3 horse-power. I can lay no claims as to the origin of the idea and the exact details of the original I have forgotten. A is a piston of the given stroke, B is a slotted cross-head, $c\,c$ are sprocket wheels, D is a connecting pin, E is an endless-chain connection. There are two pairs of sprocket wheels turning with the reciprocating movement of the piston by means of the crosshead and pin. These wheels are mounted on individual shafts which run in suitable bearings fastened to the frame. By varying the diameter of the sprocket wheels within limits the rotary speed of the shafts can be made anything desired.

"This has been used where a comparatively high rotary speed was converted into a slow but long reciprocating motion on a deep well plunger."

PROBLEM VIII, SOLUTION NO. 3, FIGS. 5 AND 5a. OTTO L. LEWIS, INDIANAPOLIS, INDIANA.

"In this solution the 14-in. stroke is reduced to a 12-in. crank throw by means of an eccentric crosshead pin, operated by rack and pinion as shown in Figs. 5

and 5*a*. The eccentric is operated through an arc of 180 degrees. It has an eccentricity of one inch and is set so that its center is toward the cylinder at the end of forward stroke. Its dead points are at the end of each stroke. Since fourteen inches corresponds to a pitch diameter of 4.456 inches, the pitch diameter of the pinion will be 8.912 inches, regardless of other conditions. By keying the eccentric in a position 180 degrees from that shown, a crank throw of 16 inches could be obtained from a 14-in. stroke. Fig. 5 is a side elevation, and Fig. 5*a* is a plan of the device."

As the crank-shaft center coincides in this device with the axis of the piston rod, and the shortening of the crank throw is symmetrical for each stroke of the piston, it is evident that the required cut-off can be secured by the common eccentric motion. I think, however, that the reversal of the rotation of the crosshead pin eccentric would make an unpleasant noise, notwithstanding such reversal takes place in the position of dead centers.

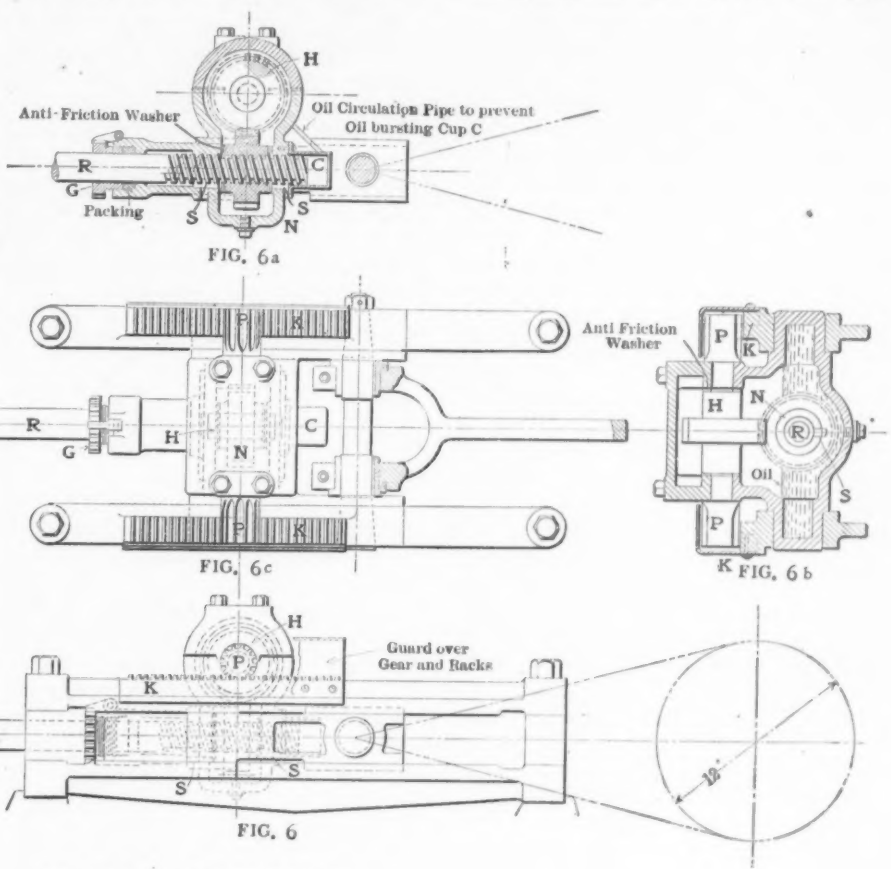


FIG. 6a

FIG. 6c

FIG. 6b

FIG. 6

SOLUTION NO. 5 TO PROBLEM VIII.

I am reserving a number of solutions and attempted solutions of this problem for a future number, and will conclude this number of the series with a solution which came later than some of those reserved. It therefore appears out of the regular order of its receipt, contrary to my general method. My reason for this proceeding is that I can best treat those reserved together in a single number of the series, and that the available space for this article cannot be exceeded.

PROBLEM VIII, SOLUTION NO. 5, FIGS. 6, 6*a*, 6*b*, 6*c*. H. G. R. CHARKOV, RUSSIA.

"The solution as shown on my drawing will be found to be one that in practice will work smoothly and well, and there are certain features about it that are worth noting. All the mechanism is enclosed in a dust-proof case, which also forms an oil bath. The oil is retained by a packed gland on the moving piston rod and by a cap at its end, which is provided with a return pipe for oil. The helical gear nut has thin bronze anti-friction loose washers running free. These may be two or three at each end of the nut boss. The screwing motion to and fro is always *assisted* by the *pressure* behind the piston, which, if the angle of the screw thread is carefully proportioned, would be a balanced pressure and nearly frictionless in work. The auxiliary advance to piston by means of the mechanism would be in exact proportion to the acceleration and retardation due to the angle of the connecting rod at its different positions in its six-inch crank circle. The whole mechanism is coupled direct to the crank and has the same stroke. The whole mechanism is compact, mechanical and light, and with modern methods of gear cutting would be subject to small wear and tear. The thread on the end of the piston rod would be better if of 'Acme' form, and the thread might be on a separate steel sleeve secured to the rod to prevent weakening same by cutting the thread. By this means also the angle of the thread could be adjusted while retaining the same diametral pitch. This would, however, complicate the gear.

"There are other ways of obtaining the required motion, but what I term *'the differential crosshead'* appears the most practical. I do not show the valve motion as any valve motion would do.

"Fig. 6 on the drawing is a side elevation; Fig. 6*a* is a sectional side view; Fig. 6*b* is a cross-sectional view; Fig 6*c* is a plan view.

"The forward end of the piston rod *R* has formed upon it a screw, cut *one* turn per inch *double*. This threaded part of *R* has a spline race cut in its entire length. This screwed part passes through the bosses in the crosshead and also through the helical gear *N*, the boss of which forms a nut engaging with the screwed part of *R*. This helical gear nut *N* is free to turn around its axis, *R*, but is retained endways by the cranked bosses. The spline race in *R* engages with spline keys in the bosses of the crosshead at *S S*, these spline keys preventing rotation of *R*. Helical gear nut *N* engages through the teeth on its periphery with a similar helical gear having same number of teeth, which is placed at right angles to *N*. At the end of the axis of *H*, which is held in suitable bearings in the crosshead, are pinions *P P* milled in the axis. The pitch circle of these two gears is *exactly* six inches in *circumference*—that is, equal to half the crank-throw circle of the crank pin, which circle is twelve inches in diameter. Each of the pinions *P P* engages toothed racks *K K*, which are fixed, being cut out of the solid guides for the whole crosshead. It follows that if the crank pin moves from its forward dead center in its movement around its circular path to its backward dead center, that is (in the given problem) twelve inches, or *vice versa*, it, through the means of an ordinary connecting rod,

draws the crosshead and its contained mechanism, also twelve inches (either direction), and the pinions *P* engaging with the fixed rack, make exactly two revolutions. The pitch circles being six inches in *circumference*, *P P* being solid with *H* and its axis, causes *H* also to make two revolutions, and *H* having an equal number of teeth as, and engaging with, helical gear nut *N*, causes it likewise to make two revolutions, revolving as a nut about the screwed end of connecting rod *R*, whose thread is of one turn to the inch, and thereby will draw the piston rod *R* two inches forward or backward as the direction of motion of crosshead may be, in addition to the twelve inches of movement of the whole mechanism of the crosshead due to the motion of the crank having a throw circle of twelve inches. We thus have *piston stroke of fourteen inches* and crank throw twelve inches.

"To allow for wear, thin brass bushes could be placed at axes of *N* and *H*, these not being shown.

"The work in connection with the job is very simple and straightforward, easy of erection and access, and easy to make with present appliances in good workshops. The spirals for teeth of *N* and *H* must of course be cut the correct hand to give increased forward motion in direction of travel of crosshead to and fro; if cut the wrong hand, a *loss* of two inches motion would occur. This would be bad, as the resistance to pressure behind piston would have to be *overcome* and a ten-inch stroke would result instead of a fourteen-inch stroke. One-sixteenth-inch clearance is shown on drawing, in cylinder."

Will Gears Work in Water Outdoors?

A reader writes us as follows:

"For transmitting about 800 horsepower, at a slow speed, from a motor, it would be convenient to let a gray-iron gear wheel of large dimensions run, out of doors, partly immersed in water. To do this would obviate the necessity of building a watertight pit for the wheel to run in, which in this case offers some difficulty. Are there any records of wheels running under such conditions? The problem seems to hinge partly upon the question if there is to be had any suitable grease that will not wash off or be impaired by the action of water and partly upon what difficulty there might arise from ice, in the cold weather. The body of water itself would not freeze as it is in motion, but would the crust of ice formed on the gear teeth, as they emerge out of the water, be likely to cause any trouble? The ice crust would, of course, constantly be crushed between the working faces of the teeth."

If any of our readers have had experience with such an arrangement we shall be glad to hear from them.

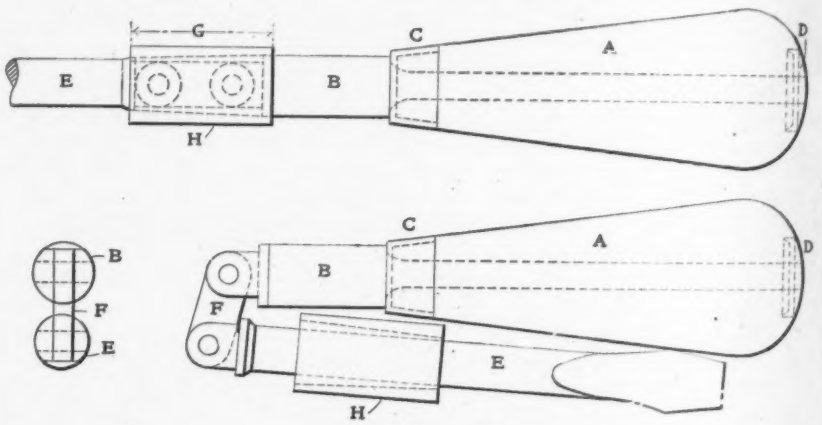
Letters to the Editor.

Doing Worthless Work.

There is one phase of work-doing which has so far not been touched upon. It cannot be called worthless work in the sense that it *does not* accomplish what it was intended for, but rather because it *does* acomplish what it was intended for. I refer to gambling devices. I knew two men, partners in a small machine shop. One morning a man came in and said to the senior partner, "I want you to drill twelve holes 3/32x3/8 inch deep in two pieces of ivory. I will pay you five dollars for the job if you will do it at once." He then produced two dice. The senior partner drilled the six holes in each of them and was paid the five dollars. He made the entry in the book, "Drilling holes, 15 minutes' time, $5." Two or three hours later the junior partner, while making an entry, noticed the 15-minute job at a trifle over 33 cents per minute. He demanded an explanation and kicked up an awful rumpus with his partner for assisting in making loaded dice. Two weeks later the junior partner signed a contract to make 25 nickle-in-the-slot gambling machines. The man who had the dice drilled may have been a conjurer, or he may have been a gambler, but it is certain the people who ordered the gambling machines intended them for gambling, and anyone who has seen the inside of one of these machines knows how little chance the player has.

Another job on which the two men disagreed was the making of the screwdriver shown in the illustration. A man claiming to be a machinist for one of the nickle-in-the-slot concerns ordered a folding screw-driver, specifying good tool steel, spring tempered. The tool was to be made to fold so as to go into the pocket readily. The junior partner claimed that the man might be a burglar; the senior partner facetiously admitted that he might be, but that as a burglar's life was a hard one at best, it was his christian duty to lighten it as much as possible by making him a really good screwdriver, which he did. Some time later the two partners split, owing partly to the fact that their views of right and wrong were so dissimilar. About a year after the junior partner had started in business for himself, I went into the shop and found him busy on an electrically controlled roulette wheel so made that the ball could be made to stop in any division the operator desired. I do not wish to comment on these men, but leave it to others; but ask these questions: Has a machinist any right to demand of a customer his life history if he brings in a job which may possibly be used for an illegal purpose? Would not the average man resent being asked to turn his family history inside out every time he bought a razor or bread knife, simply because he might want to slit someone's throat?

Several years ago I went over to England. For convenience I took a couple of books of Brown Brothers checks. When I reached Liverpool and gave my stewards their tips I was broke, as far as actual cash was concerned. I went at once to Brown Brothers' representatives, and signed, in the presence of a bank clerk, five £10 checks. What was my surprise when before paying me the money he said, "What do you intend to do with all this money? Most people cash only one check at a time." I'm not going to give my reply, but just imagine what would happen in this country if a bank clerk asked such a question every time a check for $250 was presented for payment.



A FOLDING SCREW-DRIVER.

In the screw-driver *A* is the wooden handle into which the member *B* is fitted, having a ferrule at *C* and a nut at *D*. The member *E* is joined to *B* by the link *F*. The portion *G* is tapered and the tapered sleeve *H* fits it. When the screw-driver is straightened out as in the top view a sharp rap on *D* seats the sleeve *H* securely on the taper on *E* and *B*; a tap on the end of *E* releases it. The extreme end of *E* is flattened out after *H* is in place, and is made wide enough to prevent *H* from falling off.

DIXIE.

Doing Worthless Work.

As I have had quite a lot to do making things that were finally scrapped, I was quite interested in the question about doing work that was in the opinion of the machinist no good.

While several shades of opinion were handed down, varying from "I will take all that offers" to "I will take only that which in my opinion is good," it seems to me that at least one phase of the question was overlooked, namely: Should I ask anyone to do worthless work for me? For instance, after reading what R. B. Boone has to say at page 17, Vol. 28, Part 2, I can easily believe that he would do almost any job that might happen along; further I do not think he would take any "slack" from a workman who would refuse to do a job for him just because the workman thought it would be a worthless waste of time. While I like the tone expressed in the unsigned letter at page 21, Vol. 28, Part 2, I would like to ask if its author would insist that his workman do a job that to him (the workman) was useless, and if he would insist that his workman shall do any and all jobs that he hands out, is he consistent when he refuses to do a job for a customer? Who shall be the judge? I have heard workmen declare that certain jobs were no good but they had to do them just the same. I have read the story of a man who was offered a one-half interest in the Bell telephone for five hundred dollars, but he did not believe in it. Since then he has probably kicked himself around the world several times. I have also heard that one of the United States Senators from New York missed one of the chances of a lifetime by refusing to buy Bell telephone stock in its infancy. The cause was the same unbelief.

When McKay, the man who invented the shoe machine, was on his way on foot from Massachusetts to Washington to get his machine patented, he chanced to stop for the night at a house where he told his story, which so impressed the woman of the house that she let him have $150; today her income is $15,000 a year. Verily, some have entertained angels unawares.

Not long ago an acquaintance showed me a sketch of a wheel with four weights attached. He told me it was a perpetual motion, and wanted me to make a model for him. I told him it was no use, that while he might start it going it would soon come to a stop and he'd better not fool his money away on schemes of that kind. We argued the matter for a few minutes, when he said, "Don't you ever make experiments to see whether a certain combination will work as you want it to or not?" And I admitted that I did. "Then," said he, "I am no worse off than you are; there seem to be some things that you are not sure of and want to find out, so you make the experiment and then you know. Now, I am in the same fix. I can't draw it out on paper as you do sometimes, and see why it won't go; what I want is a model to look at, and it is no worse for me to have models made for my instruction than it is for you to burn midnight oil studying your musty books to find out the whys and wherefores." And then I recalled what Prof. John E. Sweet had to say in his beautiful tribute to that indefatigable investigator of steel phenomena, John Coffin, who "In a lecture to be given on astronomy, before one of the societies at Johnstown, Pa., wished to make the statement. 'Were it possible to get behind the moon and push it in the direction it is now going it would at once begin to go slower,' fearing, as he well might, that this statement would be questioned, he devised a piece of apparatus to demonstrate it. No piece of apparatus is more interesting than this, nor could one well be made that would better prove the proposition."*

I concluded that if it were necessary for John Coffin or anyone else to make apparatus so as to be able to give an ocular demonstration to those who need it (and there are many who say "seeing is believing") there might be occasions when I would be called on to do work that, so far as I could see, would be absolutely worthless. The case in hand was one of them, so I took the necessary directions and put the job through, only to have my claim that the thing would not go, realized.

My acquaintance did not seem at all disappointed; in fact, appeared to be quite pleased with what he had, paid the bill and departed.

Since doing the job, from what I have heard I am satisfied that my customer did not have the wheel made for himself at all, but to prove the thing to be a failure to a friend of his who had the perpetual-motion idea very bad. My customer, having plenty of money, had the wheel made to stop his friend's endless clatter on the subject; and from what I can find out the scheme worked, and the device proved itself of value and no doubt was cheap instruction. Recently, a telephone engineer told me that one evening an idea came to him whereby he could put in relays so as to strengthen the current on the line which would enable him to give better long-distance service. He said that all of his text-books discredited any scheme for that purpose, that he had turned down many schemes that had been shown him by others, and yet his own idea seemed so plain that for the next few days he had his assistants putting together apparatus all for naught, but his lesson would have been cheap at several times the cost, and as a stockholder of the company I do not begrudge him the time spent in learning it.

Recently while talking about making freak things and doing worthless work with the general foreman of a shop doing a large jobbing business, he said that he did not like to do work of that sort, neither did the old man, meaning the head of the institution. They always discouraged a man who came to them with some freak or worthless device. He asked me if I ever heard the lecture, "The Man with a Hobby," and said he quite agreed with the lecture, that a man without a hobby was usually a poor stick; he liked to see and talk with a man with a hobby. For men to have a hobby was an indication they were awake and susceptible to instruction and improvement. As for myself, at present I am the mechanical end of an institution the output of which is of a chemical nature using special machinery for its manufacture. The chemical end and operation of machines is looked after by a man with ten years of experience to aid him. The man with the cash has also had some experience in the chemical part and knows some things about machines in a way, and wants all the improvements that can be made. At the very best the business is of an experimental nature, with little of a certainty to guide, and at all times has to be handled with care. Both manager and chemist have new schemes to be made and tried.

The three of us discuss the question pro and con and as the business is entirely new to me I have to find some analogy along machine-shop lines to support my view of the question that the thing in question will or will not work. As any comparison I may show along machine-shop lines fails to cross over into chemistry, I am quite frequently told to make the thing and see how it will work. As I have to get my iron work done at a near-by machine shop, I am frequently asked "What the deuce is that thing for?" About two months ago, after quite a lengthy discussion, I was told to make a certain device four in one. I maintained that one would be enough to demonstrate with, but the other two were in favor of four in one being made, and the one with the money said, "Make it," and made it was. The machine worked fine but the chemicals refused to stand the heroic treatment; the machine is now in the attic, while the experiment could have been made at one tenth the cost. When the time comes for the machinist to tell me that a certain thing or device will not work, and therefore he refuses to do the job, I may be obliged to have him make one or two parts at a time and do the assembling myself, and I may also take the work that he considers good to some other shop.

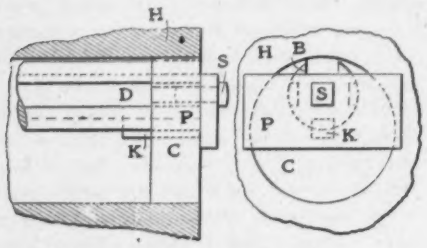
My telephone engineer tells me that a company with millions of money behind it has at least fifty men working out ideas and schemes of the company's engineers with the expectation that some time they will develop something that the public is in need of and one that will be a winner.

G. SCHNEIDER.

*See AMERICAN MACHINIST September 19, 1889.

Cutting Keyways by Hand.

At page 471, Vol. 28, Part 2, and page 159, Vol. 29, of the AMERICAN MACHINIST are shown devices for drifting out keyways by hand which are excellent. I submit a way of fitting up bars for holes of large diameters by making two collars *C*



HAND KEYSEATING DEVICE.

to fit the hole in the hub to be keyseated and bored eccentrically as shown to fit the bar *B*. The bar may have four or more keyseats as shown of different sizes.

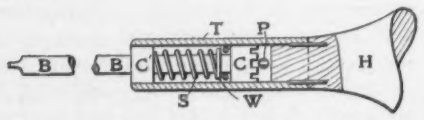
A collar *C* is used in each end of the hub and keyed to the bar as shown at *K*. These collars are turned, bored and keyseated together, then cut apart. One end of the bar is drilled and tapped for the set-screw *S*, which holds the plate *P* against the hub *H*, the bar *B* and the collar *C* on the end of the hub, where the drift is started.

One bar as shown answers for several sizes, it being necessary only to make a pair of collars for each different bore.

M. H. BALL.

A Free-Handle Screw-Driver.

The ratchet tap wrench illustrated at page 69 is somewhat like a free-handle screw-driver which I made four years ago. A ratchet screw-driver which I bought having failed owing to poor design and manufacture, I made it into the one shown in the drawing.



A FREE-HANDLE SCREW-DRIVER.

The blade *B* has fastened to it a collar C^1, a spring *S* and washer *W* are slipped over it, and the ratchet collar C is then firmly fixed to the blade. The two collars *C* and C^1 are an easy fit in the tubular handle *T*. Two small pins are then driven through holes in the tube *T* passing between the washer *W* and the collar *C*, preventing the blade dropping out and forming a thrust for the spring. The pin *P* flattened so as to engage with the slots in the collar *C*, is also forced through holes in the tube *T*. The handle *H* may be fastened into the tube as preferred, the way shown being that used in the original tool.

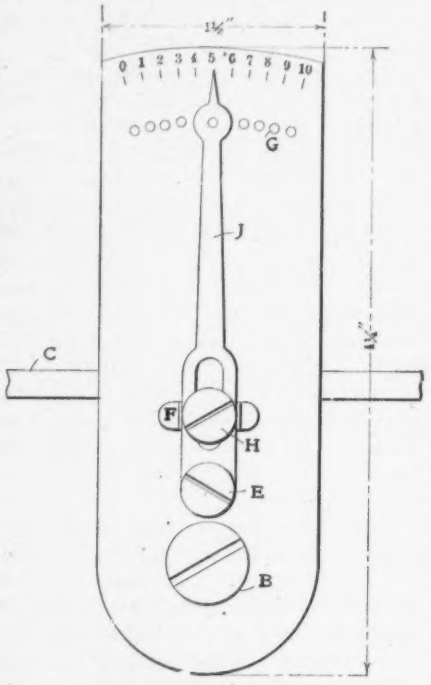
The action of the tool is simple. The pressure of the hand forces the collar *C* to engage with the pin *P* against the action of the spring, and the screw can then be turned. When the pressure of the hand is released the spring pushes the handle back and releases it so that it can be turned independently of the blade.

The business end of the blade also merits attention as in use it feels much stiffer than the usual long taper form and with it screws can be driven in more tightly. I believe that gun makers originated this form of end as being the best for their work where screws must be hard home or they will jar loose.

London, England. R. SAVORY.

Wrong Design of an Indicator.

Allow me to suggest an improvement on the indicator, attached to the carriage of a lathe, shown at page 294.

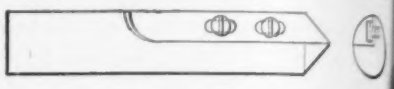


THE IMPROVED DESIGN.

If Radium had placed the pivot screw *E* at the end of the lever *J*, as shown in the sketch herewith, the sensitiveness of the indicator would be much greater than it is with the pivot placed as he shows it. Moreover, if his holes *G* were up near the long end of the pointer, they would be further apart, and so could be larger in diameter and accommodate a larger locating pin, which I think would be an advantage. The way here shown does not take any longer to make, nor require any more material than the design shown by Radium, nor does it occupy any more room than his, but by the simple expedient of properly locating the pivot screw, the sensitiveness is increased fourfold or more. The numbers, of course, would read in the opposite direction to his, but I can see no serious objection to that. The primary office of an indicator is to magnify motion, and the more the motion is magnified the more efficient the indicator becomes. WALTER GRIBBEN.

Brass Workers' Experiences Wanted —A Burring Tool.

"Letters to the Editor" are to me very interesting and instructive. I wish more brass-workers would give experiences and suggestions, for in brass work 2000 to 4500 pieces a day is not unusual. Therefore any suggestion which will save the least bit of time or effort will be welcome to him who has to work hard every minute of the day to make a fair showing.



A BURRING TOOL.

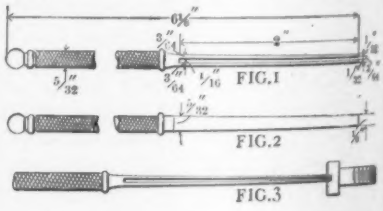
The illustration shows a burring tool which will cut freely without chattering. Brass articles with holes through them, machined from rod stock, must be burred to remove the bur thrown in by the cut-off tool. To take this bur out with a free-cutting tool and have no chatter marks was the aim in designing the tool. The cutter can be adjusted to suit the work, and can be taken out to sharpen. We find no trouble burring 3/8-inch nuts deep enough to remove one thread.

BRASSY.

A Screw-Holding Screw-Driver.

The sketches show a screw-driver for very small screws. This is very useful when small screws have to be put in place, in the interior of typewriters, adding machines, or any like machine in which the hand cannot hold the screw while starting it.

Fig. 1 is a side view showing the two prongs on which a slight pressure is exerted when a screw is to be held. As



A SCREW-HOLDING SCREW-DRIVER.

soon as the pressure is removed the prongs spring back gripping the screw quite firmly.

The handle of the rod should be nurled so that a good grip is afforded the fingers in turning. Also the whole should be made out of a spring-steel rod, and the ends made quite thin in order to have the spring as sensitive as possible. Fig. 3 shows the method of using this screw-driver. After it has been used for a time it will be found invaluable to the assembler of light machinery. H. S. G.

Special Reamers for Gun Work.

Dixie's three-fluted taps remind me of some three-fluted reamers, which we have in constant use and which, unlike the taps,

can be measured with the micrometer after being hardened and ground.

Their design will be of interest to gun makers, as they are used expressly for stock removing in gun-barrel work under oil pressure.

Fig. 1 shows a three straight-fluted reamer, nicked with the ordinary left-hand thread. One of the three oil grooves is illustrated at *A* leading from the hollow shank to its respective flute. The hollow shank, which is not shown, is a plain cylindrical tube. It fits over and is soldered to the shank end of the reamer, covering the oil grooves and confining the oil until it reaches the flutes. Three flutes are best as they afford the largest chip spaces. The cutting edges are unevenly spaced, which gives freedom from chatter. The blank should be turned 0.02 inch larger than finished size, threaded 3/64 inch deep, the flutes milled, as shown in the end view, hardened, and ground to size. The measurements are taken on the line *B C* drawn through the center, the cutting edge of one land, and the heel of the one opposite; after which the lands are backed off for clearance, as indicated by the dotted line *D*.

The taper at *E* forms the choke in the muzzle. The portion near the shank from *F* to *G* is relieved sufficiently to prevent scratching when the reamer is being removed from the work.

This style of reamer has been in constant use for a number of years on all sizes of shot-gun work, and has proven to be the most successful of any-

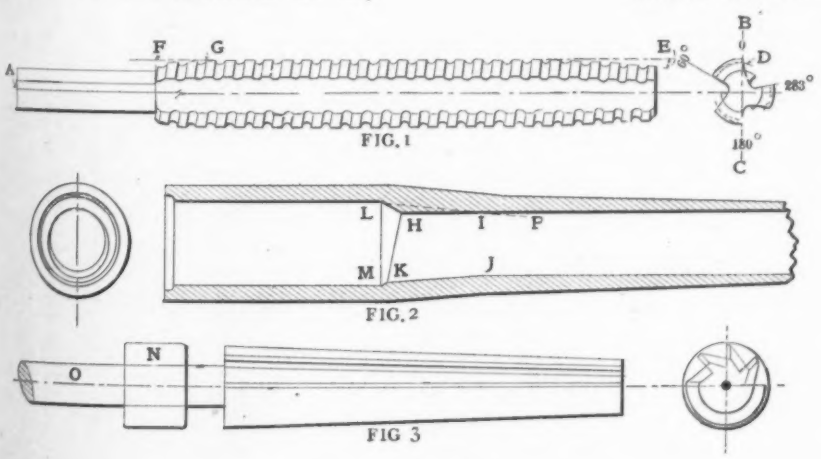


FIG. 1

FIG. 2

FIG 3

SPECIAL GUN REAMERS.

thing we have ever tried for this purpose.

We also use a hand reamer for repairing work, that I have never seen elsewhere. Its value will be better appreciated by considering the nature of the work shown at Fig. 2, which represents a sectional view of a gun barrel, bored and chambered for the shell. It will be noticed that the throat *H I J K*, leading from the chamber to the bore, is not concentric with the chamber and leaves the shoulder *L H* greater than the opposite side *M K*.

If the work had been properly done such a condition would not exist, but where large quantities are manufactured on a piece-work scale such conditions do often occur and must be remedied as far as possible. For this purpose a reamer was designed having the proper taper and fluted on one side only as shown at Fig. 3; the other side is left plain. Being operated by hand the shoulder at *H* can be removed without altering the shoulder *K*, a few partial turns being sufficient to bring the throat to the proper condition indicated by the broken line *P*. This operation was formerly done by blocking out one-half of the teeth of an ordinary taper reamer with a thin piece of sheet copper, but the liability of the copper to slip out of place and spoil the work, together with the time wasted in adjustments, led to the designing of the reamer now in use, which has given satisfaction for the past six years.

In order to protect the chamber from injury and to keep the reamer in proper alinement a ring pilot *N* is provided which is an easy running fit on the shank *O*; the outside diameter is an easy fit for the chamber.

This tool can be operated by a common tap wrench on the end of the shank, which should be square. E. PIERCE.

Winding Springs—A Shaper Job—A Stripper.

As a die and press tool-maker it falls to my lot to use a number of springs, and it sometimes happens that the particular size I want is not in stock; and sometimes a special size is wanted. With the arrangement shown in Fig. 1 I can make an infinite variety of springs.

At first I took any piece of round wire about the thickness required and bent it to form a crank handle, but later, when its utility was proven, I made a handle as in the sketch. This enables me to use any piece of drill stock without bending it or injuring it in any way. Having the

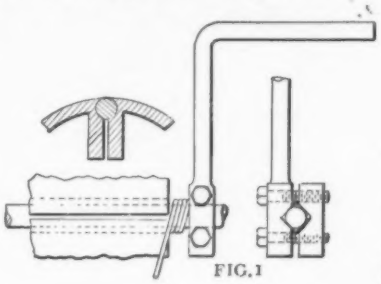


FIG. 1

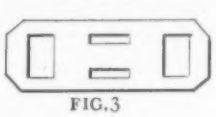


FIG. 3

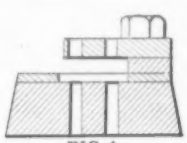


FIG. 4

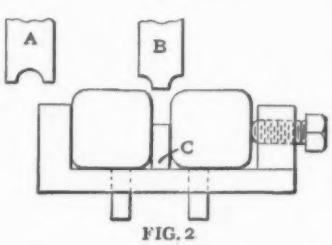


FIG. 2

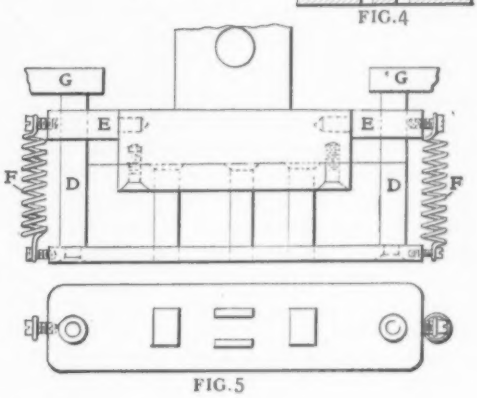


FIG. 5

WINDING SPRINGS—A SHAPER JOB—A STRIPPER.

drill rod with the handle attached, the rod is placed in the lead jaws in the vise and the leads tapped over on the top so as to form a seat or bearing for the rod to turn in. The end of the spring wire is then inserted in the handle alongside of the rod; then, by turning the handle, the spring is coiled as shown. To vary the pitch, the angle at which the wire is fed is varied; the coarser the pitch wanted, the greater must be the angle. I find I can wind as good springs on this as on the lathe, and without any bother changing gears.

One of our youths had a job on the shaper. Some hundreds of steel blocks were wanted which were about 1.25 inches square and 1.5 inches long. They had to have the corners rounded, and the way he did it was to set them up in the vise diagonally and use a tool like *A*, Fig. 2. This was the method till one day the boss, coming that way, stopped to watch the work. Said he to the youth: "In about eight weeks another raise is due you, is it not?" "Yes," said the youth, "and I hope I'll get it, too." "Well, you make better time on that job and you shall have it in two weeks." When the boss had gone the youth set to, found the clip shown in side view in Fig. 2, put in two pieces of drill stock the right distance

apart to locate the affair by the slot in the bottom of the vise, made a tool like *B* and soon was turning the blocks out in better time. At the end of two weeks he got his raise. The piece *C* is simply a loose piece of packing a little wider than the end of tool *B*.

On taking charge of a power-press shop some time back I found that on a number of jobs the grinding and renewal of tools were costing too much. The work was the piercing of a number of blanks somewhat like Fig. 3; a simple enough job, to be sure. The die was arranged as in the cross-section in Fig. 4, and it will be seen that the stripper was fixed to the die. This left only a small space through which to feed the blanks, consequently the operator sometimes failed to locate the blank properly in the gage. This threw the tools over; also on stripping the work frequently fell back in the gage exactly, and sometimes stuck; then the operator would trip the press the second time, which did not improve matters; so I made some strippers like the one shown in Fig. 5. The stripper itself was made longer than usual and two studs *D D* were riveted into it, as shown, these studs working freely through holes in lugs *E*, which were attached to the punch holder, the springs *F* simply serving to keep the stripper in place. This leaves the whole of the die and its gage in full view of the operator, so that any faulty work is usually due to gross carelessness on the operator's part.

The sketch shows the punch holder and the stripper when the press is at rest. In operation the springs *F* hold the stripper up as the punch descends, thus clearing the gage, etc., on the die. As the ram ascends, the studs strike against pieces *G*, which are bolted to the housing of the press, and so the blanks are stripped.

B——, England. CYCLO.

Tools for Threading Pipe Plugs.

The taper threading die and carrier shown herewith are used in the works of the N. M. Company for making gray-iron pipe plugs like Fig. 1. The body of the die, Fig. 2, is made of gray iron and is fitted to a hexagon turret. The four slots are so placed ahead of the center that the cutting ends of the chasers are tangent to a circle equal to ¼ of the diameter of the thread to be cut. The chasers are made of stock of sufficient thickness to leave a projection beyond the cutting side to take up the spring of the threading tool. After the threads are formed this projection is cut away to leave a true cutting edge, and the backs of the chasers are milled at an incline of 0.01 inch to the inch, tapering down toward the thread, so that when the set-screws are tightened the chasers are tilted backward to relieve the threads. The chasers are spotted for the 120-degree pointed set-screws, the spots being offset to permit the screws to force the blades outward and backward to their seats in the body when tightened.

The carrier Fig. 3, consists of two parts, the chuck *A* made of machinery steel, and the plug *B* of tool steel, hardened and tempered. The chuck is fitted to the spindle of the turret lathe, and the hole for receiving the various carrying plugs is fitted with two keys, which are held in place with dowels. The square end of

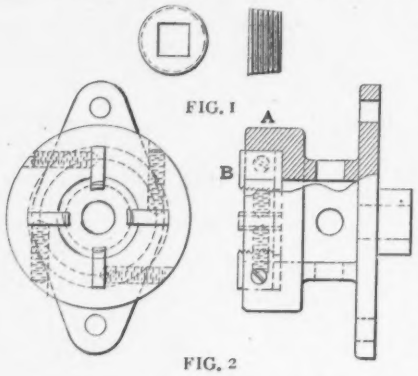


FIG. 2

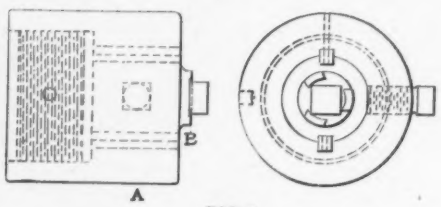


FIG. 3

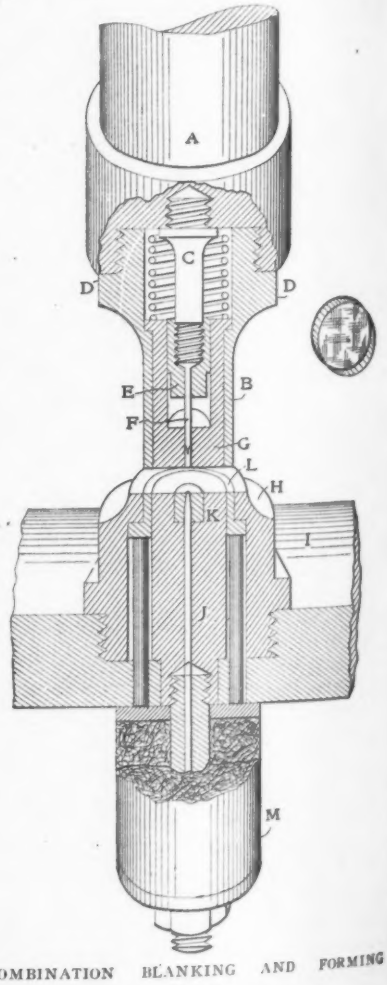
TOOLS FOR THREADING PIPE PLUGS.

the carrying plug is made to fit loosely into the hole of the pipe plug, so that when the threading die is brought up to the work the latter is seated squarely against the three projections on the shoulder. These countersunk pipe plugs are made in sizes ranging from ½ to 3 inches, and are not milled or turned before threading. The patterns for them are of such dimensions that grinding the scale off the periphery will leave the plugs the correct size for threading. A narrow rim is also put on the lower or smaller side of the pattern to permit grinding on a disk to leave a clean surface for the starting of the die. The dies are used with lard oil as a lubricant and make a smooth thread. H. E. R. MANBRAND.

Combination Blanking and Forming Punch and Die.

I would like to show through the columns of your paper a punch and die for producing a cap as shown to the right in the sketch. The die is of the combination type. It blanks and forms the cap at the same time, and punches a hole in the center, the hole being a No. 60, by B. & S. drill gage, and in my opinion it would be a hard matter to have a punch as delicate as this stand up in a gang or follow die and do the amount of work this die will do. After the die was put into the press, it did 40,000 pieces without the punch being ground or replaced, which is quite an item, the stock being tin. I trust the tools may be of interest especially to the home guards (as the rounders call us) and I am thankful for one that there are mechanical papers published for one to gain new ideas from, and so keep abreast with the times.

The shank or punch holder *A* is of machinery steel, and is bored out and threaded to receive the pieces *B* and *C*. The forming and blanking punch *B*, is of tool steel, being turned to the shape shown, and is threaded so as to screw into the punch holder *A*. It is milled hexagon at the points *D* to permit it to be screwed into, and removed from the holder. The punch is hardened and drawn to a dark straw color. I did not grind it to size, as it did not change appreciably in hardening. The punch holder *C* is of machinery steel, and made to screw into piece *A*; it is also threaded to receive the nut *E*, which is of tool steel, hardened, and holds the punch *F* in position. The knock-out *G* is of tool steel, made a nice working fit in the



COMBINATION BLANKING AND FORMING TOOLS.

punch *B* and drilled to receive and support the punch *F*, this also being a working fit. The knock-out is worked by the spring at the top as shown. The lower part of the die is constructed along lines similar to the punch. *H* being the cutting or blanking die, is of tool steel,

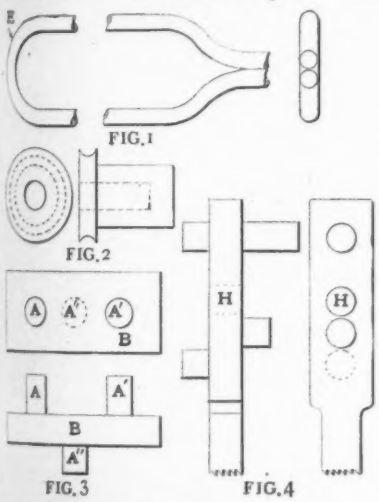
hardened, drawn to a dark straw color, and threaded to screw into the gray-iron piece *I*, which permits of the die being held in the bolster plate or shoe. The flange of *H* is also milled hexagon, the same as the punch *B*.

The forming plug *J* is of tool steel, and made a driving fit into the piece *I*. It is bored out to receive the small die *K*, which, being made in this way, can be readily replaced. The piece *L*, which is a cushion ring and stripper combined, is of tool steel, and is worked by pins which are made long enough to come into contact with the cushion rubber *M*.

W. VAN ORMAN.

A Bending Jig.

The illustrations show a bending jig which was used to shape pieces of round steel wire to the form at Fig. 1. Two rollers, Fig. 2, were turned from steel and the hubs fitted to holes in the base, which was a flat cast-iron plate. The



THE WORK AND DETAILS OF THE BENDER.

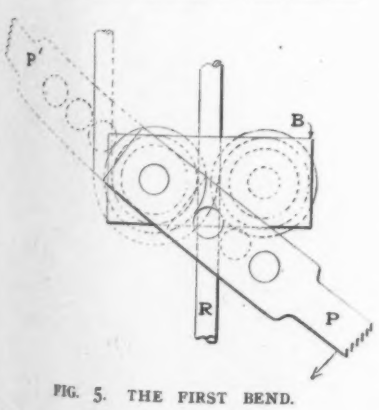


FIG. 5. THE FIRST BEND.

pins *A A'* were set in a block, Fig. 3, for the rollers and the pin *A''* was fitted to the hole *H* in the lever Fig. 4.

The operation is as follows: The lever being placed on one of the rollers and set in position *P* Fig. 5, a piece of wire *R* is pushed between the rollers as shown. The lever is then swung in the direction of the arrow to position *P'* forming the first bend as at *E*, Fig. 1. The block *B* Fig. 3, is now put on the rollers and the lever turned over and placed on top as at Fig. 6.

The rod which is now U-shaped is again inserted between the rollers to the

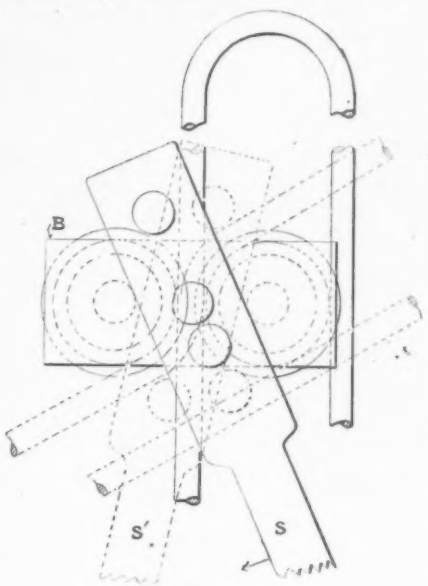


FIG. 6. THE FINAL BENDS.

proper distance, and the lever pushed to the position shown at *S'* which produces the double curve shown by dotted lines. The rod is now reversed and the other leg operated on in the same way, which completes the piece as at Fig. 1.

Cleveland. M. B.

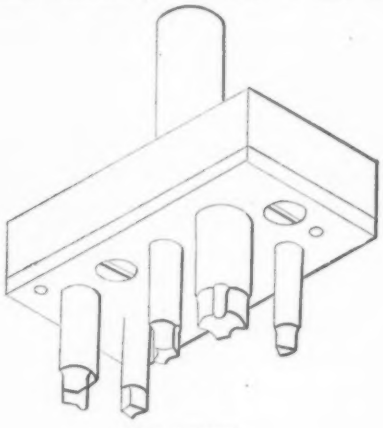
Wood Rolls.

L. L. Arnold, at page 450, tells of the method used in making wood rolls for textile work. Some years ago I had to get out an order for 5,000 wooden rollers for lumber-piling yards. They were 30 inches long by 6 inches diameter, and the shaft extended 3 inches at each end. Pine logs were supplied 8 inches square; after cutting to the right length the corners were sawed off. A wooden box holder was rigged up on the face plate of a 32-inch lathe, and the pieces were shoved in after the center of one end was roughly marked. A laborer with a long-handled auger provided the feed power, and the hole drilled ran clear through. Needless to say it often came out at the other end far from the center, but there was always enough stock to remedy this. The shafts were 1⅛-inch round iron. Each was heated in the middle and a sharp chisel driven nearly through. In this slit was placed a cold feather which protruded about ½ inch. The part which was in the shaft was well nicked, and when the hot iron was closed on it and cooled, there was no danger of looseness. Centering and straightening was the next job, and then they were driven into the wood. A rough cut was taken, bringing it to within about ¼ inch of finished size. The ring slots in the ends were cut and rings were driven in hot, water being applied at once to prevent burning. Hard-wood wedges were the next item, and the rolls then went to the finishing lathe where the ends were also faced to length, the rings being driven in about ½ inch below surface. Rolls previously made in this way lasted as long as fifteen years, although they were exposed the year round to weather which in northern Ontario is none too moderate.

W. L. McL.

A Punch and Stripper.

The sketch shows a style of punch that I have never seen described, and it may be of interest to some of your readers. It is used in punching filigree work and in making various kinds of ornaments. The stripper is made of tool steel ⅝ inch thick. This is laid out from the die after the latter has been hardened, and then the stripper and punch holder are fastened together by screws and the holes for the punches drilled through both pieces. The holes are then reamed with a reamer made from the same size wire as the punch. The reamer is simply a piece of drill rod cut off and beveled slightly on the end that is to do the cutting, after which the wire is ground down on a slant as far as the center and hardened. These reamers work nicely if they are



THE PUNCH.

required to take out only 0.003 to 0.005 inch, but will cut large if much heavier duty than that is required of them. They are run in a speed lathe or a small drill press. A series of boxes is provided in which is kept wire of all the sizes used on this work together with a suitable drill and reamer in each box.

After the stripper and punch holder have been reamed they are taken apart, and the punch holder is countersunk on the back. The drill rods are cut to the required length, headed over on one end and inserted in the punch holder. A small hole is then drilled, half in the holder and half in each punch, and a wire is driven in to keep the punches from turning in the holder. The stripper is secured in place on the die and the dowel pins are put in, after which the punches are laid out and finished in the ordinary way, hardened and drawn to a spring temper. The punches must fit

the stripper as closely as possible and still be free to slide. The punch holder is secured to the shank by means of two or more flat-headed screws and two dowel pins. Punches made in this way have cut miles of stock in a quick-running press before being worn out. Owing to the thorough manner in which the punches are supported by the stripper, they are very stiff and stand up well to the work. For this work it is well to carry Stub's wire in every size from No. 60 to 5/8 inch. Where these punches are made in large quantities, a good bench lathe with milling attachment is a great time saver.

WILBERT S. DREW.

Illinois State Reformatory.

A Radius Gage.

The illustration shows a handy male and female radius gage. I have three

A RADIUS GAGE.

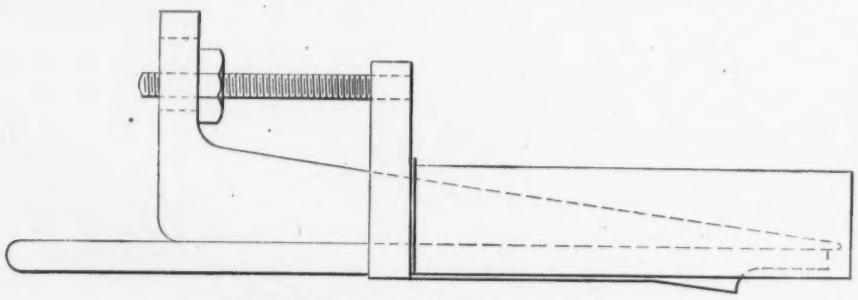
which I made—one rising by thirty-seconds, one by sixteenths and one by eighths, giving me a range from 1/32 to 1 inch.

GEO. GRONNER.

Davenport, Iowa.

Cutting Keyways in Pulley Hubs by Hand.

Seeing in the AMERICAN MACHINIST at page 471, Volume 28, Part 2, also at page 159, Volume 29, a device for cutting keyways in pulley hubs, although it is an old one, it having been in use when I was an apprentice in 1849, I am sending you an



CUTTING KEYWAYS IN PULLEY HUBS BY HAND.

improvement upon it. Some years ago having need of something for a similar job, which could not be done on a slotter, I made what I thought was an improvement on the old way of shimming up with strips at each cut. I enclose a rough sketch which will show how it was made. I have not attempted to make a mechanical drawing of correct proportions as the tools used were a pocket pencil and a two-foot rule. I had a piece forged with a flange at one end; after being turned to size, the slot was planed at an angle or taper and a wedge piece was made with a gib head having in it a slot through which passed a stud, the other end of which was tapped into the flange on the first piece mentioned. The stud was provided with a nut which held the gib wedge in place, while the drift or broach was driven through. The taper of the wedge was made to suit the taper wanted in the key seat. By turning the nut on the stud at each cut made, the feed was obtained.

J. W. Mc.

Making Steel Springs on the Punch Press.

The spring, made of 1/8x5/8-inch steel, is shown at *A*. *D* is the blank punched out in a separate operation. The dies for forming are two rollers *E* and *F* mounted on two journals *G* working in a sort of box

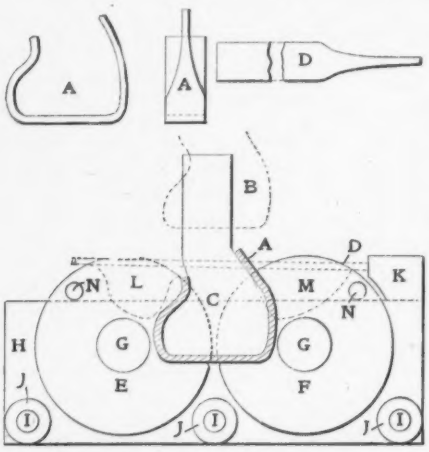


FIG. 1. FORMING SPRINGS IN THE PUNCH PRESS.

having two sides *H* joined together by three bolts *I* and spaced apart by the sleeves *J*, one on each bolt. In the illustration, Fig. 1, one of the sides *H* is left out. The punch is shown at its top position by the dotted lines at *B*. When the punch is at this position, the grooves in the forming rollers are at *L* and *M*, also shown by dotted lines. The red-hot blank *D* is then laid on top of the rollers, with one end against the stop *K*. The punch then descends till it reaches the position *C* and the spring *A*, shown section lined, is formed; the punch then ascends to *B* and the spring is pushed off the punch. A pin *N* on each of the rollers *E* and *F* comes in contact with the top of the side *H* on the return stroke and prevents the roller turning too far. This device was shown me some time ago by Edward Board, 618 Chestnut street, Philadelphia. The idea, which was new to me, struck me as being very good. Recently, while in conversation with another friend of mine, who makes springs which could be bent in the same manner, I mentioned that I had a sketch of a good spring-

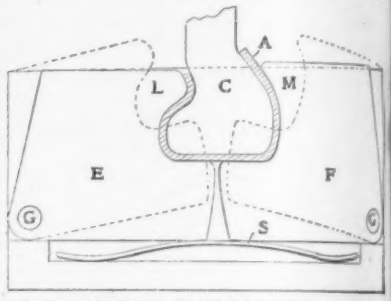


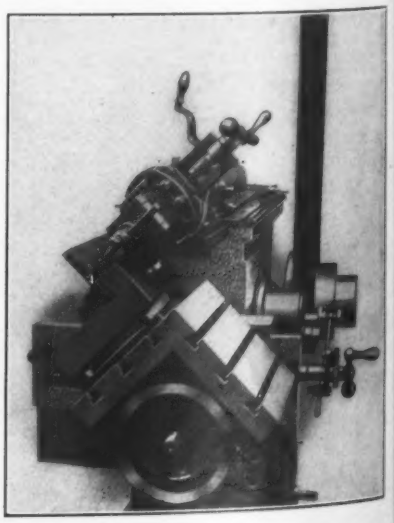
FIG. 2. ANOTHER WAY TO DO THE SAME JOB.

bending device to be used on the punch press. He then, before seeing it, sketched the device shown at Fig. 2, showing a different way of working out exactly the same problem. I have used the same spring *A* as an illustration, although the springs made by the two men were entirely different. The only difference in the two rigs is that a heavy spring *S* is used in Fig. 2 to keep the members *E* and *F* open.

DIXIE.

Cutting Steel into Strips in the Shaper.

We were out of 1/4x1/2-inch tool steel, and needed some short strips for cutters. We had some 3x1/4-inch stock to get them out of, and a piece of it was given to the



CUTTING STEEL STRIPS IN THE SHAPER.

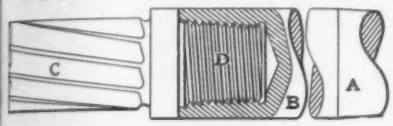
planer hand to cut into 1/2-inch strips. The shaper had a swivel table, so the shaper hand set the table over forty-five degrees one way, and the head forty-five degrees the other way, put the steel in the chuck edge-ways, a 1/8-inch parting tool in the tool post and sliced off the required pieces. It may be an every day trick, but

I never saw it done before. It was done so neatly I took a snap shot of it for the benefit of your readers. The advantages of a swivel table are many, but this is one I never saw utilized before.

A. P. PRESS.

High-Speed Steel End-Mills with Machine-Steel Shanks.

A is a machine- or tool-steel shank, with an extension *B* having a high-speed cutting portion *C*, fitted as at *D* with a



HIGH-SPEED STEEL END MILL.

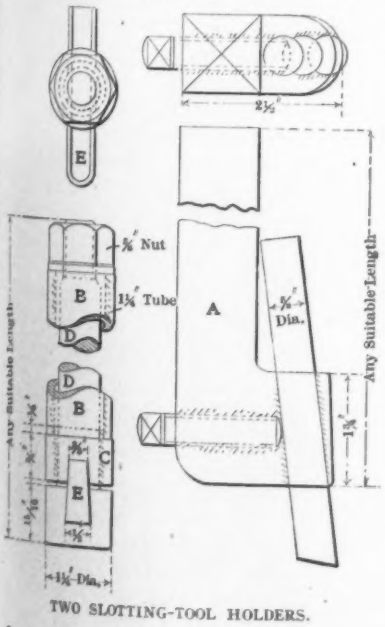
taper-threaded joint—not less than two inches per foot taper. *C* is so made that when dull it can readily be removed and a sharp one inserted without any loss of time.

ABEL A. MILLER.

Two Slotting-Tool Holders.

The accompanying sketches show two slotting-tool holders which are used by a firm I recently worked for. *A* is a mild-steel forging made to suit the tool clamp of the machine; it is planed square so that work can be machined at right angles by turning the holder a quarter way round instead of moving the table.

B is made of suitable tubing to suit the tool clamps of the machine. The collar *C*



TWO SLOTTING-TOOL HOLDERS.

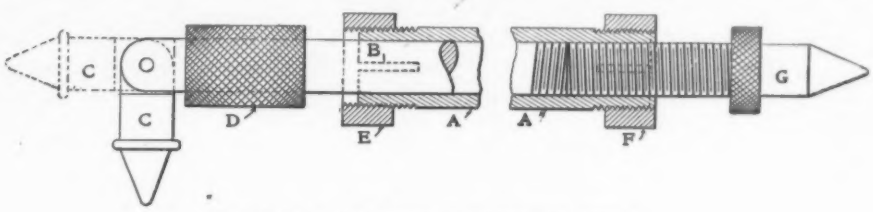
fits loose so that the tool may be moved to any angle desired without slackening the clamps. The stud *D* is made of mild steel with an elongated hole to suit the cutter *E*. One of the many advantages of these holders is that the machinist can have a stock of cutters; as they become dull the tool grinder can replace them with others, and in that way keep the machine more constantly at work.

England. W. W. Y.

Internal Gage with a Knuckle Joint.

The illustration shows a gage for internal work such as eccentric straps, where the ordinary telescopic gage is of little or no use.

A is a piece of tubing threaded externally at each end for the clamping nuts *E* and *F*. One end is threaded internally for the adjusting screw *G*. The ends are also split as shown by the dotted lines so that the nuts *E* and *F* will clamp the parts *B* and *G*. The part *B* has a knuckle joint *G* which which swings on a pin. The nurled sleeve *D* is a sliding fit on the rod *B* and knuckle joint *C*; when slid up against the shoulder on *C* it holds it in alinement



INTERNAL GAGE WITH A KNUCKLE JOINT.

with the tube *A*. After the measurement has been taken the sleeve *D* is slid to the position shown in the illustration, the knuckle joint is turned as shown and the gage can be removed.

ALPHEUS.

Drawing Room and Shop Kinks.

Not long ago the advertising manager came into the drafting room to wash some blue-prints made from negatives. It happened that the drain to the tank was stopped up and the tank could not be emptied at once in the usual way. So the advertising man went down and interviewed the man in charge of piping, etc., and told him he must open that drain pipe immediately. The man told him he was not a plumber, but he would uncouple the pipe as far as possible and see if he could locate the trouble. At this point the advertising man had a brilliant idea; he said: "I can't wait for you to go to all of that trouble; but just get the compressed air hose in here and blow that drain out." The hose was held on the top of the drain pipe and air at 100 pounds pressure per square inch turned in. It was a complete success.

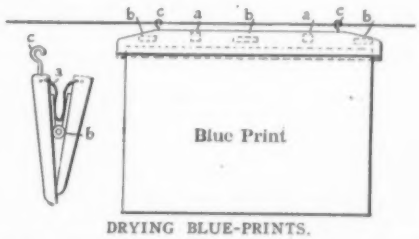
This was another reminder that there are a lot of short cuts which, if we only knew them, might help us out once in a while.

Did you ever watch the blue-print boy handle a large thin print when removing it from the tank to hang up to dry, and notice how it tears, and if he does get it hung on the line or clips how it hangs and dries unevenly? The hanger shown in the sketch is an idea I am going to try, to overcome this. The method of handling it will be to take the hanger and let it clip the blue-print in the water, then the whole thing can be lifted out easily and hung up straight to dry.

I heard of a man who wanted to bore a hole through the ceiling in his house, and his wife said to him: "You can't do that without getting plaster and chips all over the carpet." The man smiled, but said nothing. He got a brace and a bit, also a paste-board box, bored through the bottom of the latter and left it on the bit, got on the step-ladder, bored the hole, caught all the plaster and chips in the box, and so saved the carpet.

A somewhat similar arrangement was used at the Grant Tool Company's shops when hobbing a worm wheel. Before placing the wheel on the vertical arbor, a flat, shallow tin pan larger than the wheel with a hole in the center to fit the arbor, was put on. This caught the chips and saved the slide from extra wear. Also in the case of a brass wheel, it kept the chips from getting mixed.

At the Ingersoll Milling Machine Company's shops in Rockford, Ill., quite a time saver was introduced, several years ago, for turning over the heavy milling-machine platens or tables when scraping. It was customary then to lay the table flat on horses and pull the table over (after it was scraped) with the crane. Someone noticed the trunnions cast by the molders at the center of each end of the table,



DRYING BLUE-PRINTS.

as a convenience in handling. The thought suggested itself, why not use these trunnions to support the table while scraping and so rock it around on them?

This was found to work well, and I remember after this time putting larger trunnions on the drawings of the tables, and also designing a special pair of supports with sockets on the top that these trunnions would fit. These supports were made with three legs and bolted to the floor, making a very substantial and neat-looking rig.

ERNEST J. LEES.

Of course we did not intend to say, near the bottom of page 556, that the final paragraph of Professor Duncan's article is *in*significant. We said significant. The printer put on the in.

An Automatic Press Feed.

BY GEORGE DEAN.

Having had considerable experience in designing and making press-tools for a plain power-press, and finding that not the least trouble to be overcome was the nature and locality of the stop to be used, it struck me as being of no mean advantage to adapt the machine so as to accurately regulate its own feed to such an extent as would cover the range usually met with. Perhaps another and more important item was the cost and risk attached to the making and hardening of the dies for doing some classes of work which could have been done so much easier if two operations had been permissible. Last, but not least, consideration of the increased output of the machine would surely provide the necessary stimulus. Having therefore decided to attach an automatic feed, the question arises as to the best way in which one could be worked. Levers worked by a cam placed on the crankshaft are not satisfactory, a stroke of say six inches being difficult to get, and a ratchet-wheel and pawl out of question for the accuracy required, while a plain feed between rollers is too uncertain. Therefore I fixed on a reciprocating cage that would definitely grip the work, and decided as the most convenient way, to obtain the stroke from the ram. The stroke of the ram being too short, a multiplying movement composed of two levers is added to give a stroke of a satisfactory length, and at the same time provide adjustment. A slight difficulty now arises, as the stock must be stationary during the time the punch is passing in and out of the die. This occupies a portion of both strokes, and a locking arrangement is therefore provided for the cage at the end of its stroke, a slight portion of the stroke being necessary to release it before the forward movement is begun. By locking the cage at each end of the stroke this pause can be utilized for gripping and releasing the stock while the cage is stationary, thus insuring a definite amount of travel that is accurately repeated at each stroke. A small set of rolls is provided beyond the back end of the stroke for the stock to pass through, these serving the double purpose of straightening the stock and making it sufficiently rigid for the cage to pass backward while the stock is perfectly stationary.

Fig. 1 shows complete side and end elevations, and plan. Fig. 2 shows each part in detail. *A* is the bracket carrying the cage, etc.; it has a slot cast in it for the stock to pass through. Other details of the bracket are easily gathered from Fig. 1. *B*, Fig. 2, shows side and end elevations of the cage, with its adjusting strip and screws. *C* is a side view and plan of the tongue, which together with *D E F*, are the parts which grip the stock, the under surface of the cage *k* acting as the anvil. *D* is a shoe which fits between the stock and the top of the tongue; preventing the tongue from damaging or marking the stock. *E* is an end view and plan of the cam upon which the tongue *C* works; it is fitted with a nut for locking it. *F* is the cam, with side levers *t*, for raising the tongue and shoe, forcing it against the stock. It will be seen that by moving the cam *E* round it adjusts the tongue for the various thicknesses of stock used. It is advisable to graduate the pin to suit standard thicknesses, and to have the cam say ⅛ inch out of center, which will allow for stock from 0 to ¼ inch thick, being passed through. It is advisable to watch that the end of the tongue when lifted by *F*, is quite clear when the thickest stock is being used, as *F* does not vary in its action at all, adjustment being made entirely by *E*. It will also be seen that any strength of grip required can be regulated by *E*, from the lightest pressure on thin stock, to a strength of grip that obviates any risk of slipping, even when the heaviest stock is being used. *G* is the lever, which with the pins *n* unlocks and works the cage backward and forward. The small bracket *H* carries the locking-pin *O* and spring. When the cage reaches the end of its stroke, the locking-pin slips into hole *p*, in the side of the cage, thus locking it. On the movement reversing, the lever *G* is drawn over, raising the pin *n*, which forces the locking-pin *O* out of the cage, when the pins *r* having reached the ends of the slots, the cage is carried forward or backward, the movements being repeated at each end of the stroke. By means of the levers *t*, operating from *G* to *F*, the work is gripped, or released, as the case may be, while the cage is locked, the two movements occurring simultaneously, the cam *F* being at its full lift before the cage is at liberty at one end, while work is fully released before the cage moves at the other.

P and *R* are the connections for *G* and *W* respectively, and are connected by the lever *T*, they are made so that they can be adjusted, *R* being adjusted on the levers *W* or *W*¹, to roughly give the stroke desired, the length of stroke being accurately reached by adjusting *P* up or down the lever *G*, thereby lessening or increasing the pause at the end of the stroke. It is advisable to graduate the

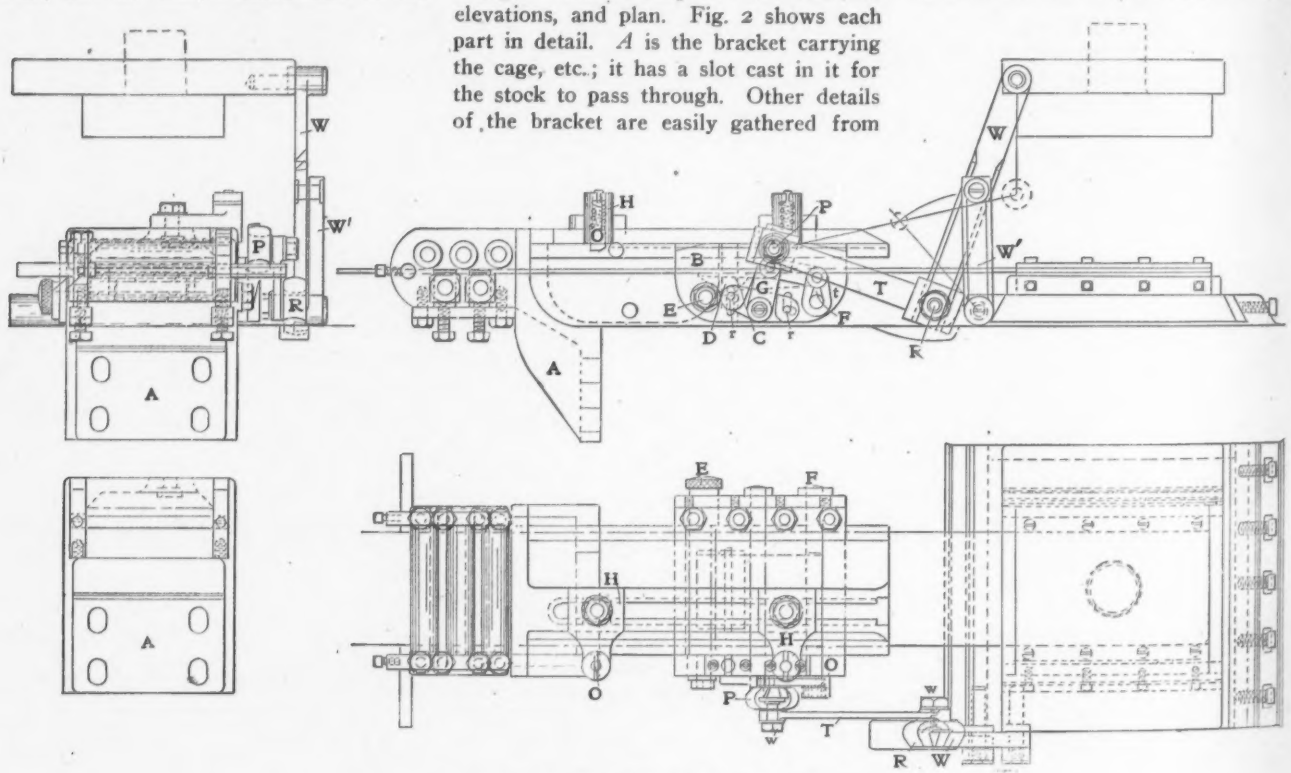


FIG. 1. AUTOMATIC STRIP FEED FOR PRESS.

lever G, so that any error in the travel of the cage after adjusting R, can be at once remedied. The connections P and R are fitted with a small plate u, to prevent the screws w from damaging the levers. The levers W and W^1 are of unequal length, and while the short one is tapered the entire length, the long one is only tapered to just past the center pin, the reason being that the connection R only slides level with the center pin, any shorter stroke being obtained by turning the levers round, and using the shorter one. For instance if a long stroke is desired, the levers are placed with the short one W^1 outside, when the long lever W is in position for the connection R. If a shorter stroke is desired than is obtained when the connection R is opposite the center pin, the levers should be uncoupled and taken off, replacing them with the long lever W outside, when the short lever W^1 will be in position for the connection. Both levers are made with bosses as shown, to be of such a length, that when the levers have the washer x between them, the bosses should be flush with the side of the levers; this insures their being correct when turned round.

The cage is fitted with a tempered steel plate z, to give a good wearing face where the locking pins engage with the holes p. Both the pins and plate are easily renewable, when worn to such extent as to destroy the accuracy of the travel.

All the pins, joints, etc., should be hardened if convenient, and the holes bushed, so as to be easily replaced when worn.

The rolls should be of hardened steel, and run in mild steel bushings. If the rolls are soft, they will wear so quickly, as to be useless in a few months, whereas a good set of hardened rolls will wear for years without trouble. Two pieces of steel, easily set and locked by two small set-pins, are shown, to guide the work through the center of the rolls, or in line with the die if it should not be central.

This attachment is provided for doing more and better work, and does away with the necessity for making so many elaborate and costly dies, this item alone soon paying for the cost of installing it, independent of the extra work from the machine. It was designed for work on a Bliss arch power press, but with a little alteration can be adapted to any type of machine. To more clearly explain the method of working, the lever T is shown connected to the cage well off the side, and to avoid confusion the details are shown accordingly. This method of driving would cause binding in the slides, and should be avoided in practice, the distance from the drive to the center of the cage being kept as short as convenient.

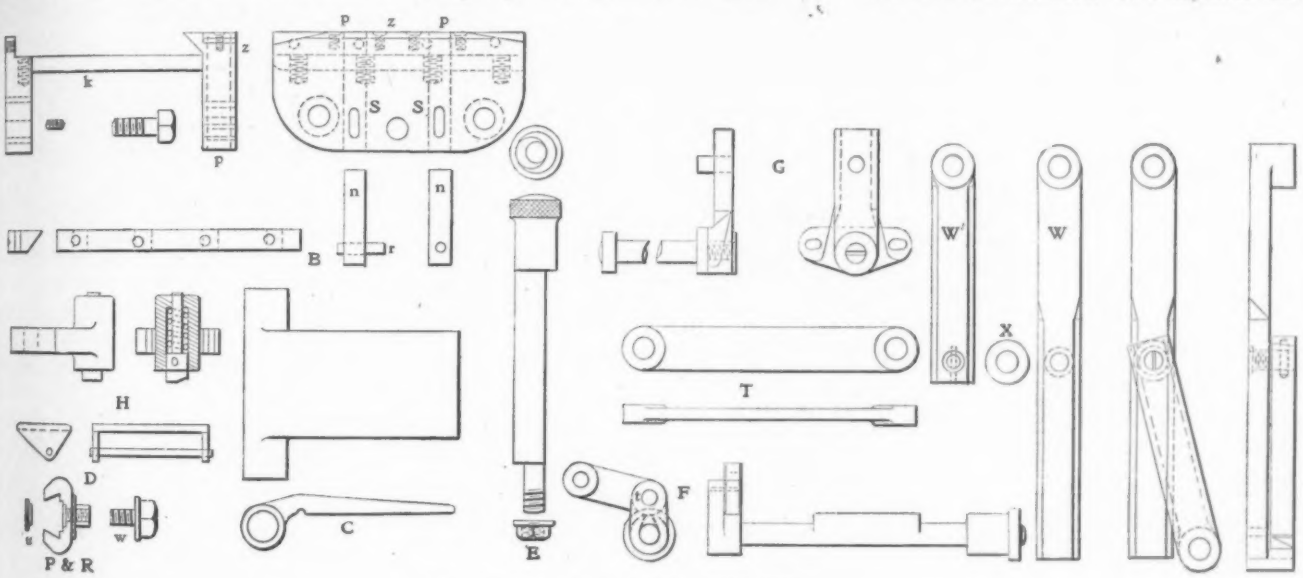


FIG. 2. DETAILS OF THE PRESS FEED.

Fuel Tests at the University of Illinois.

A series of investigations of unusual interest to Illinois manufacturers and other coal operators is about to be undertaken at the State Engineering Experiment Station recently established at the University of Illinois. An extensive and somewhat elaborate series of experiments with the different Illinois coals is contemplated for the purpose of determining the most economical methods for their utilization. Tests of fuels will be made: (a) under power-plant boilers; (b) in residence-heating boilers; (c) in gas producers; (d) to determine their chemical composition and heating values. The fact that Illinois is the second coal-producing State in the Union, and also the fact that in the period from 1850 to the present year Illinois has advanced in rank among the manufacturing States from fifteenth to third render these investigations of much importance. In order that the tests should be so conducted as to meet with the approval of the great manufacturing and coal interests and that they should produce results of real value, co-operation was desired with the leading engineers, coal operators, railroad officials and manufacturers, from whom advice and suggestions would be available. The co-operation of the State Geological Survey and the University departments of applied chemistry and mechanical engineering was already assured. Accordingly several of the leading engineering societies of the State were invited to appoint representatives to form a conference committee to meet from time to time for the discussion of matters relating to these problems. The initial meeting of this conference committee was held at the University, Urbana, Ill., on March 14, 1906, at which time the general policy of the committee was outlined, and plans for future work discussed. It is expected that the coals tested will be donated for this purpose. The plant in which the tests are to be made will not be ready for operation until some time in May. In the meantime the details of the plan of procedure will be prepared and issued.

A prominent automobile racing man who has promised to reward well the chauffeur who would win for him in the Vanderbilt cup race, received among numerous applications one containing the sentence: "I am known among my friends as a very wreckless driver." Now what did the writer mean, wreck-less or reckless? And which would have been the better qualification? Also which qualification would be most apt to get him the job?

A machinists' supply house in New York City received the following postal sent from a little town down in Georgia:

"Deer Sur—Plees sen me yore caterlog of supplizes.

"Yores truely,

"____ ____.

"P. S.—You need not sen it. I have change my mind."

Drafting-Room Bookkeeping.

BY GEORGE F. SUMMERS.

The matter of keeping books and records in a drafting-room might well be called the question of keeping down costs, for that is its principal object. Like all systems of bookkeeping, this one is based on two fundamental principles: First, to determine the very smallest amount of information that will answer, and, second, to find the simplest and easiest way of getting the same. Often one sees some system started, carried on laboriously for a short time and then die a natural death, without anyone knowing just why. The reason, generally, is this: The method is too expensive; that is, it takes someone's time and thought each day to keep it running; a great many small details are obtained that are not vitally necessary, and the cost of these little details bankrupts the system. A system should be so craftily arranged that it will run itself and be always strictly up-to-date without anyone realizing that an effort is being made to keep it so.

In every drafting-room there is a certain amount of money paid out each year for salaries, in return for which the company gets a certain definite return in the matter of drawings. As a question of good business management the chief draftsman should know exactly where this money goes, so that he may give as large returns as possible for the money spent. Not only can he stop promptly any leaks in his housekeeping, but he can reduce the cost of the next job when the present one is found to cost too much; not so much by saying unkind things to the draftsman as by removing obstacles that have prevented his economical working, which generally means better supervision and a more careful planning of the work.

Blanks, Figs. 1 and 2, have been designed to keep track of and distribute the money spent by the draftsman. The amount he will receive in the course of a year divided by the number of hours' labor he gives in return will give the price he should charge per hour. This should be kept in dollars and cents and not in hours, as it not only saves each day an operation—the computing the money from time to time—but gives to the draftsman the value of each piece of work, and helps him to cut out the unnecessary.

The time sheet, Fig. 1, is ruled in horizontal lines for days, and in vertical columns for different drawings, or other work, and should state plainly and truthfully for what the money was spent. It should be made out by the men each evening at the close of work. The chief draftsman then has opportunity, after the men have left for the night, to go down the room and see what has been accomplished and what it has cost, and where the drawing is not enough for the money he can plan a remedy at once, before the cost gets too high.

DRAFTING ROOM - TIME SHEET

Draftsman *Thomas A. Brown*

Time for month of *March* 1906

	Piston Rod, Eng. 310 6179	Boiler, Eng. 310 6231	Weighing Counterbalance Blocks, Eng. 290	Absent
1	4 1 2			
2	4 1 2			
3	2 0 0	2 1 2		
4				
5		4 1 2		
6		1 6 0	5 2	2 7 0
7				
8				
9				
10				

FIG. 1. THE DRAFTSMAN'S TIME SHEET.

Blank, Fig. 2, shows a page of the drafting-room ledger. The items from Fig. 1 should be copied each day by the office boy *and footed up* so one can tell at a glance what a drawing has cost. The sample page shows that the pencil drawing, carried forward from page 850, cost $8.41, and that up to date the total represented by the tracing is $15.83. The item 5660 represents a page of the ledger on which general expenses, such as computing, designing or absences are entered temporarily to be split up and distributed among the drawings. Books that are gotten up in great detail and balanced to a cent each month are not what is wanted in a drawing-room. Within a few cents either way is plenty close enough, and the information given by the records must be *keen working knowledge* to be used *each day* in keeping down the costs. The ledgers are made up with 100 pages to a book, each page representing a tracing, paper drawing or photographic negative. For a drafting-room containing 20,000 drawings, 200 ledgers would be required. When printed pages are not available on account of price very good books can be made of manila paper printed with a gelatin copying-pad, and bound with string. The cost of the material for such a book is about two cents. The time cards, similarly, can be made of blue-line prints from a master brown print, twelve at a time, for about one-third of a cent each. At the close of a month the time cards should be bound and filed.

TITLE; *Boiler for S.P. Engine No. 1064.* RECORD NO *6231*

LIST *Boilers.*

| COST | | | |

are furnished blue-line prints from the brown. The two columns at the right of the ledger page are used to enter the latest revision date and the date of receipt at the local works of the brown print; as this is a special case which would probably not be used at another shop, the sample is not filled in in these two columns.

This system contemplates a serial number for each drawing. When paper or cloth is purchased it is at once cut into the required sizes, the firm's name and general title printed (by the printer) and a serial number stamped on the sheet, this serial number representing a ledger page. Every sheet is then accounted for without the chance of any being lost or wasted, and no time is taken by the draftsman in cutting paper or printing titles, but the entire working day is spent as it should be, in getting lines on paper.

The system as outlined above provides, in the following manner, for a record of each change made on a tracing.

Before correction, a brown print is made from the tracing, and on this print the proposed changes are marked in yellow pencil. The print is then filed under its record number. In this way each tracing will have perhaps a dozen brown prints on file representing the way past work was made, a new date being added at each step to the tracing.

Resistance of Iron and Steel to Reversals of Direct Stresses.

At the ordinary meeting of the Institution of Civil Engineers, of London, on Tuesday, April 10, 1906, the paper read was by T. E. Stanton, D.Sc.,M.Inst. C.E., and L. Bairstow, A.R.C.S. The following is an abstract of the paper:

While recognizing the valuable work which has been done by previous observers in the study of the fatigue of metals the authors call attention to the fact that further experimental work on the subject is much needed for the following reasons:

1.—Practically all the previous work, with the exception of Reynolds and Smith's experiments, has been done by subjecting the materials to transverse stresses, the intensity of which has, therefore, to be calculated by the ordinary theory of bending.

2.—The resistance of the materials in common use by engineers at the present day when subject to reversals of stress is imperfectly known, and there exists considerable difference of opinion as to the materials best suited for stresses of this kind.

3.—Although it appears from Reynolds and Smith's experiments that the resistance of iron and steel is seriously diminished when the alternations are very rapid (i.e. 1500 to 2000 per minute), it is not known if this reduction in resistance is considerable at those speeds which are common in high-speed reciprocating motors (i.e. in the neighborhood of 800 reversals per minute), since the majority of experiments have been made at approximately 60 reversals per minute.

4.—Although it is generally recognized that the effect of moderately rapid or sudden changes in section of materials subject to reversals of stress is to diminish their resistance, the amount of this reduction in strength for the various materials commonly used is not known.

5.—The common assumption that, in cases in which the stress varies from tension to compression, but between unequal limits, the resistance depends solely on the range of stress and not on the actual values of these limits, has not been experimentally verified.

From these considerations it was decided to undertake a research, the object of which should be the experimental determination of the resistance of certain kinds of iron and steel, under the special conditions mentioned in the above paragraphs, when subject to reversals of direct stress.

The experiments were made on the alternating stress testing machine which has been designed and constructed at the National Physical Laboratory, and which has been fully described in *Engineering*, February 11, 1905.

Jointly with this work, a microscopical investigation has been made of the changes which take place in the crystalline structure of materials under reversals of stress as the test proceeds, to determine if possible the manner in which ultimate failure occurs.

The materials upon which the tests have been made may be conveniently divided into three groups:

1.—Three samples of Swedish bessemer steel and one sample of Swedish charcoal iron presented by R. A. Hadfield for the purpose. The carbon content of the steels was approximately 0.17, 0.44 and 0.64 per cent.

2.—Four samples of steel presented by Messrs. Belliss and Morcom for the purpose. Of these, two were mild-steel bars, one was a bar of harder steel used for piston-rods, and the fourth consisted of specimens which had been cut from a large steel forging.

3.—Two samples of wrought iron of British manufacture, bought for the purpose of the tests.

Although more uniformity in the results of the tests would no doubt have been obtained by subjecting all the speciments cut from any given material to an annealing process, it was felt that this would detract from the value of the tests owing to the well-known effect of heat treatment on the resistance of steel. For this reason the tests were made on the bars as received; and in cases in which there were several bars of the same material, the specimens in any group of tests were not always cut from the same bar. This does not apply to the case of the specimens whose structure was examined microscopically, in which the actual resistance was of secondary importance.

The results of the experiments may be stated briefly as follows:

1.—The superiority, in resistance to reversals of stress, of moderately high-carbon steels over low-carbon steels and wrought irons, which was discovered by Wöhler to exist when the rate of reversals was 60 per minute, still holds when this rate is increased to 800 per minute, although according to Reynolds and Smith's experiments this superiority no longer exists when the rate of reversals is in the neighborhood of 2000 per minute.

2.—As far as comparisons can be made between the results of the present experiments and those of Wöhler and Sir Benjamin Baker, there is no marked reduction in resistance due to raising the rate of reversals to 800 per minute.

3.—Experiments in which the ratio of tension to compression varied from 1.4 to 0.72 indicated that between these limits the value of the maximum range of stress was practically independent of the actual values of the limiting stresses in tension and compression.

4.—The resistance of the materials in three typical cases of rapid reduction of area of the specimens has been determined.

5.—The failure of iron specimens due to the development of the slip-lines of Ewing and Rosenhain into cracks has been determined for the case of direct stress; and the failure of moderately high-carbon steel, due to the development of cracks in the ferritic areas of the structure has also been established.

An American who has lived in Japan for some years past informs us that when a Japanese soldier goes to war he and his relations assume that his life has been given up; he is in a sense regarded as already dead since he is willing to die and expects to do so, his only object being to kill as many of his enemies as possible before his own time comes. This idea is shown in the naming of their steamships and naval vessels. All their merchant vessels are given compound names of which Maru, meaning a circle or "return," always forms the latter portion, but in naval vessels this is omitted; they are not expected to return but to be sacrificed.

The March-April issue of the *National Civic Federation Review* is devoted largely to the subject of "Welfare Work", a topic which was discussed at length by employers and labor representatives at the last annual meeting of the Civic Federation of New York.

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Contents.

	PAGE
Roll Grinding	563
A Large Cylinder Boring Machine	565
Piece Work	566
"Compo" Pulley and Clutch	567
Catalogs for the Foreign Trade	567
An 84-Inch Engine Lathe with Long Bed	569
Legal Notes	569
American Inventors in the German Patent Office	570
Relics of James Nasmyth	571
Unemployed Workmen Law in England	572
Epochs in Marine Engineering	573
New Designs of Gas Producers	578
Echoes from the Oil Country—Not Willing to Take Advantage of All Opportunities	579
Studies in Inventive Problems—XVII	580
Will Gears Work in Water Outdoors?	584
Letters to the Editor	584-591
An Automatic Press Feed	592
Fuel Tests at the University of Illinois	593
Drafting-Room Bookkeeping	594
Resistance of Iron and Steel to Reversals of Direct Stresses	595
The Bill for Free Alcohol	596
Great Inventions for Sale	596
New Tools and Machine-Shop Appliances	597
Worcester Metal Trades Association	598
Inquiry for Machinery	598
An Anecdote of Edwin Reynolds	599
Semi-decennial Statistics—Iron and Steel Industries in the State of Maryland	599
Summer School for Artisans at the University of Wisconsin	399
Personal	600

The Bill for Free Alcohol.

It is understood that the bill for the abolition of the revenue taxes on alcohol to be used in the arts, and which passed the House of Representatives by a strong majority, having now fallen into the hands of a committee of the Senate, of which Senator Aldrich is chairman, will be "hung up" for the remainder of the present session for "investigation of the question."

Our readers have been made somewhat familiar with the nature of the arguments in favor of making alcohol free for use in the arts or for industrial purposes; we have shown how many industries are obliged to use it; how Germany, by making it free, has stimulated the growth of many branches of industry which would, without cheap alcohol, be impossible; how important it is becoming as an alternative to gasolene for automobiles, launches and small engines; how well adapted it has proven in Germany for lighting by means of mantle burners, and how important an industry it becomes from the standpoint of the agriculturist, who, often on ground not well adapted to any other use, may raise a crop suitable for the production of alcohol.

The arguments in favor of cheap alcohol seem to be almost innumerable: the valid arguments against it seem exceedingly scarce, if not, indeed, nonexistent.

But there is one argument which, though not valid, is powerful, and that argument is the Standard Oil Company, which, if alcohol could be obtained at low rates for lighting and power purposes from crops grown anywhere and everywhere, might not be able to get quite as much as it now gets for its gasolene, and a sinister feature of the whole affair is that the Senator who is understood to be holding up the bill is closely allied with the head of the Standard Oil Company, each being a grandfather of the same infant and the Senator being now and for a long time past charged with being a "Standard Oil Senator."

Automobilists on the one hand, as would-be consumers, and farmers on the other, as would-be producers, are understood to be thoroughly aroused in regard to this bill, and there are those who declare that such pressure will be brought to bear for its passage that even a Standard Oil Senator must yield. As to that time alone can tell, but we hope the bill will pass, and if it does we predict a still greater boom for the automobile, and the extended use also of internal combustion engines for many purposes and in many sections of the country where the cost of gasolene now prevents their use.

Great Inventions for Sale.

We received some time ago a circular from the inventor named below in an item we find in the *Electrical World* as follows:

"Mr. C. L. Staub, architect, of Omaha, Neb., has issued a circular to all and sundry offering 'four great inventions for sale.' One of them is a steam boiler with a fuel saving of 400 per cent. Another is 'a new motor to produce electricity or run dynamos by reharnessing the lost 85 per cent. of coal power that now goes out of the chimney.' The others are not less important. Original drawings of these revolutionary improvements can be had for from $100 to $300, and the whole thing, lock, stock and barrel, can be had for the absurdly cheap price of $150,000. The inventor gives highly adequate reasons, however, for his willingness to accept this paltry sum. He says that he wrote to Mr. Edison on the subject some weeks ago, and got no reply; 'and now I am going to make him look small.' God speed the day!"

We have little doubt that when Mr. Edison sees this he will instantly reply to that letter, and put "in haste" on the corner of the envelope.

Secretary Taft took another dig at ex-Chief Engineer John F. Wallace, of the Panama Canal, the other day, but we suppose Mr. Wallace will not much mind it, especially since it seems there are those who have sufficient faith in him to place him at the head of an important company which will take over the stock of Westinghouse, Church, Kerr & Co., and beside doing a general engineering and construction business will be affiliated with important financiers and will be the holding company for the securities of electrical enterprises. No doubt Secretary Taft feels much chagrined at the loss of the services of Mr. Wallace but most of those who have followed the matter will agree that Mr. Wallace's course has been much the more dignified and creditable and that the conditions as he found them, entirely justified him in giving up the attempt to carry through the work. It is an elementary principle that men who are to be held responsible for the accomplishment of a certain work must be given control of the means of accomplishing it. It has been made plain that Mr. Wallace's control was nothing like commensurate with his responsibility and there was nothing for him to do but to resign. Abuse of him may do very well for some purposes but will hardly convince engineers that Mr. Wallace did anything but what he had a right to do and which it was his duty to do.

In view of the fact that the riveted structures composing the framework of San Francisco's most modern buildings stood the shock of the earthquake well it is declared that the new city will be composed of steel-framed buildings, though what assurance there can be of that unless the law restricts builders to that material

we cannot see. In any event it is probable that a great deal of structural steel will be called for there and there seems to be practically "unanimous consent" that the import duties on such steel shall be suspended say for a year, so that the prostrate city may get the necessary material as promptly and as cheaply as possible, and the element of time will be as important as the price, for as is well known our own steel mills are all oversold for a long time, and it is even now announced that the U. S. Steel Corporation will erect an immense works in Indiana to enable it to more nearly fill its orders. If the English, German and Belgian mills can help to rebuild San Francisco within a reasonable time it will not only be a good thing in itself but will avert a congestion of orders in our own steel mills which might seriously hamper general construction work for a long time to come. Indeed building operations have already been much interfered with and the strike which took place this winter among the structural-steel workers in New York actually did not at all interfere with or postpone the completion of the United Engineering and other buildings because it only enabled the steel deliveries to catch up a little.

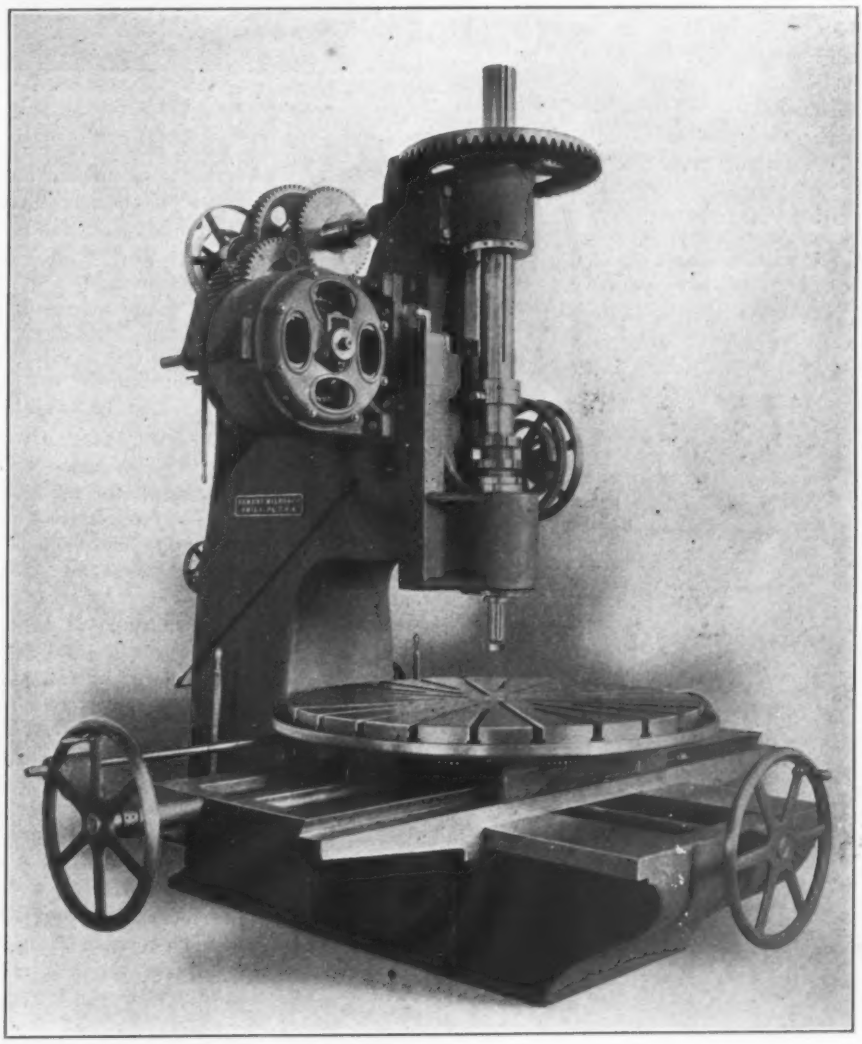
The *Autocar* (England) calls attention to the desirability of standardizing the names of automobile parts, a movement similar to what was once inaugurated for cycle parts by a paper read before the Automobile and Cycle Engineers' Institute. It would contribute to accuracy of description and avoid misunderstandings, as well as make the vernacular easier of acquisition by a novice, if we had a uniform nomenclature instead of the present multiplicity of English terms, intermixed with French and partially Anglicized words: thus we should have one word to designate the ignition-controlling device, instead of distributer, timer, commutator, etc. In this case the last term quoted, though much used, does not appear to be appropriate, as it does not correctly describe the function, but merely refers to the similarity this device often bears, in construction and appearance, to the commutator of a dynamo. We wonder if it will be possible to abolish the practice our English friends (and several on this side also) have of using the word "motor" when they mean a vehicle propelled by a motor, and of using this word as a verb?

With the Bureau of Forestry and a few others who have an eye to the future, planning how to preserve our timber, the development of new methods of using it go merrily on. A concern which makes a large variety of articles from wood pulp, is now advertising paper milk bottles, also paper bottles for beer, catsup, etc.

New Tools and Machine Shop Appliances.

VERTICAL MILLING MACHINE.

This machine is driven by a motor which is bolted directly to the frame. The motor is of 10 horse-power capacity and spindle speeds from 17½ to 84 turns per minute can be obtained through two trains of gearing. The spindle is of steel, 5 inches in diameter, and has a vertical traverse of 22 inches. At its lower end it is held in a sliding head which forms a stiff support for the cutter at all positions of the spindle. The cutter mandrel is held in position by two circular nuts on the spindle; the lower one locks it in and the upper one forces it out of the spindle. A counterweight placed inside the frame of the machine is provided to balance the spindle and slide.



VERTICAL MILLING MACHINE.

The distance from the center of the spindle to the inside of the column is 33 inches; the vertical distance from the table to the frame is 20½ inches. The compound table has a longitudinal movement of 28 inches, a transverse movement of 60 inches, and supports a circular table with trough around it for catching lubricant. The table on this particular machine is 60 inches in diameter. The feed shaft for the circular feed may be swung out of gear to permit the table to be rotated by hand for adjusting the work to its position. Four changes of feed in all directions are provided for the table, and the same number of vertical feeds for the spindle, may be provided, where required. The machine is equipped with a pump, tank and piping. The builder is the Niles-Bement-Pond Company, New York City.

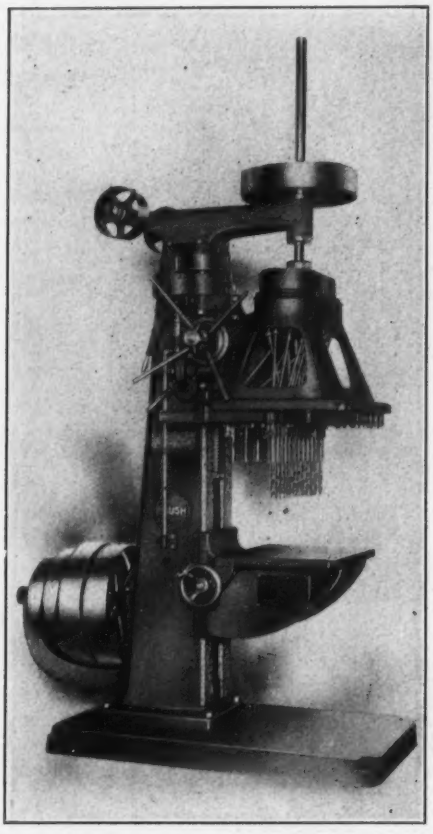
A NEW ELECTROMAGNETIC FRICTION CLUTCH.

The Pick Electric Company, 95 Liberty street, New York, has brouht out a new magnetic friction clutch for the operation of planers. The entire mechanism is very neat, being inclosed in an iron box with the motor coupled to one of two shafts, while the other shaft is coupled to the first motion shaft of the planer. The clutch is made to drive the machine in both directions by two connections, one of which is by a high-speed chain and the other by a pair of gears, the motion given by the two being obviously in opposite directions. The difficulty due to the resid-

ual magnetism which has caused much trouble with devices of this character is claimed to be overcome, but of the manner of doing this the company has failed to give us any information. The clutch is applicable to existing planers by removing the pulleys and connecting to the pulley shaft.

A MULTIPLE SPINDLE DRILL.

This machine is designed for the rapid drilling of automobile crank cases, cylinders, pumps, electrical slate work, etc. The capacity is sixteen 3/16 to ½-inch holes in cast iron or steel. It will drill 16 half-inch holes 1 inch deep in cast iron in 20 seconds. It has a two-speed countershaft so that either high-speed or carbon drills may be used. The capacity of the rectangular head is 16x20 inches. The machine can also be made with a circular head up to 16 inches capacity. The spindles are made of tool steel running in composition bearings, which have for each spindle a vertical adjustment of 13/16 of an inch. The head is counterbalanced on the post, and is operated by rack and pinion. It has

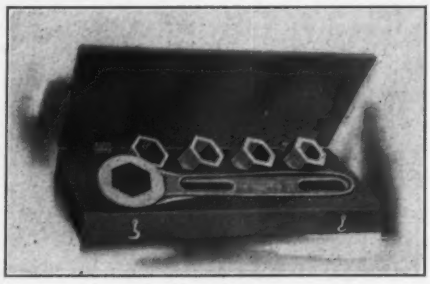


A MULTIPLE SPINDLE DRILL.

three feed changes which operate in connection with a quick reverse mechanism, and has also an automatic knock-off. The table is adjustable on the post, and is raised and lowered by hand. The base of the machine is planed so that in case long work is required to be drilled, the adjustable table can be removed from the post and the work set on the base. The net weight of the machine with countershaft complete is about 3600 pounds. It is made by the Baush Machine Tool Company, Springfield, Mass.

A RATCHET WRENCH.

The illustration shows a ratchet wrench with interchangeable bushings which has recently been put on the market. The tool is made in two sizes. The smaller wrench has a 10-inch handle, the head is 13/16 inch thick by 1 15/16 inches diameter, and it takes bushings fitting cap-screws from ¾- to 1-inch inclusive.



A RATCHET WRENCH.

The larger size has a handle 14 inches long, the head of which is 1⅜ inches thick by 3⅜ inches diameter; it takes bushings fitting cap-screws from ⅞- to 1½-inch inclusive. The bushings are retained in the head by a small flat spring.

These wrenches are made by the Bay State Tool Company, Boston, Mass.

SOME SMALL ELECTRIC TOOLS.

Several motors for small labor-saving machines such as an electrically driven bench drill suitable for small work, a portable electric breast drill for the same range of requirements and an electric buffing and grinding outfit for household use, have recently been developed and placed on the market.

The bench drill is furnished with a vertical motor mounted on the top of a column sliding in a socket cast integrally with the base, in which it can be adjusted for various hights. The motor body or head is also adjustable radially for drilling position. The minimum hight is 16 inches when the motor arm is in the lowest position and the maximum hight is 22 inches when the motor arm is fully raised, thus giving a range of 6 inches through which the motor body may be raised or lowered. The work is fed to the drill by raising the circular table which is operated by a lever with a range of 1¼ inches vertically.

The motor is series wound and can be supplied with 115 or 230 volt winding, for use on direct-current circuit only. A single gear reduction is provided between the armature shaft and drill spindle. The largest drill the chuck will hold is 21/64 inch diameter, and from this all sizes down to No. 40. The bearings are provided with self-oiling cups which require attention only every three or four months. The outfit includes a chuck, ten feet of attaching cord and an Edison attaching plug. The weight of the bench drill complete is about 40 pounds.

The motor used in the portable electric breast drill is similar in size and construction to that used with the bench drill just described. The tool is provided with a suitable switch on the body of the motor so arranged as to bring the drill under control of the operator. The weight of the breast drill is 16 pounds complete and it measures 13 inches long by 3 inches diameter. With the outfit is furnished a chuck and extension cord with Edison attaching plug, permitting a range of operation within a radius of ten feet from the source of current supply.

The domestic grinding and buffing outfit has been especially designed for grinding knives, scissors, and other similar edged tools and for polishing small silverware, jewelry and other like articles.

These tools are built by the General Electric Company, Schenectady, New York.

Worcester Metal Trades Association.

We have received from Chas. E. Hildreth, of the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., the following particulars regarding the annual meeting of the Metal Trades Association of that city:

The Worcester Metal Trades Association held its annual meeting and banquet Tuesday, April 24. The election of officers resulted as follows:

President, George F. Brooks, Harrington & Richardson Arms Company; 1st vice-president, Edward M. Woodward, Woodward & Powell Planer Company; 2nd vice-president, A. W. Whitcomb, Whitcomb-Blaisdell Machine Tool Company; secretary, M. C. Snyder, J. E. Snyder & Sons Company; treasurer, J. P. Bird, Hobbs Manufacturing Company; George I. Alden, of the Norton Emery Wheel Company, John Back, of the F. E. Reed Co., A. E. Newton, of Prentice Brothers Company, B. G. Luther, of B. G. Luther & Co., members at large.

About one hundred and fifty sat down to the banquet and the speakers were, J. A. Emery, of New York, secretary of the Citizens' Industrial Association of America, and George B. Hugo, of Boston, president of the Employers' Association of that city.

Inquiry for Machinery.

(184). Wanted, names of manufacturers of machines for making leather fillets.

We received from the Baker Platinum Works of Newark, N. J., a card table of comparisons of Troy, Avoirdupois and Metric weights, which is arranged in very convenient form for showing the equivalents of the various ounces and pounds we use, except the apothecary, and also the figures representing their relation to the

various metric denominations of weights. Most people think that though the avoirdupois pound contains 16 ounces and the troy pound only 12, the ounces themselves are the same. This is not the case, however, and the table shows the differences between the ounces and all other differences between the various denominations of weights which one is likely to need to know in connection with industrial operations.

The Free Public Library of Newark, N. J., which, as many of our readers know, is a very important manufacturing city, has begun the collection of trade catalogs with a view to keeping them on file for reference by interested parties. Those of our readers who issue catalogs might do well to send a copy to the librarian.

An Anecdote of Edwin Reynolds.

The Allis-Chalmers Company, having built eleven 3500-kilowatt standard cross-compound, vertical direct-connected engines for the Metropolitan Street Railway Company, was called upon for advice as to the type of engines to be used in the immense new power house then being planned by the Manhattan Railway Company, in New York City. It was the intention of their engineers to install units of 5000 kilowatts capacity. The first type of engine considered was the cross-compound, vertical machine, similar to those furnished for the Metropolitan Street Railway, and some correspondence passed between Mr. Reynolds and the engineers of the Manhattan Railway Company on the subject, so that finally Mr. Reynolds was invited to come to New York and discuss the matter in detail. Mr. Reynolds left Milwaukee with the question of the type of engine still unsettled, but with the understanding that the straight, cross-compound, vertical unit would be used if it were found practicable. On the train, en route for New York, however, Mr. Reynolds evolved in his mind the possibility of using a combined vertical and horizontal engine, allowing four cylinders to be connected to the one shaft, and before reaching New York, he was prepared to offer to the engineers in charge a definite proposition covering a combined vertical and horizontal four-cylinder engine, now generally known as the "Manhattan" type, and furthermore he submitted to them the size of cylinders which he would recommend, the size of crank pin and cross-head pin and the size of main journals, with rough sketches of the proposed unit as he had planned it in his mind's eye. As a result of that conversation, the Allis Company received orders for eight pairs of such machines.

On Mr. Reynolds' return to Milwaukee, work was at once begun on the design of the new engines in accordance with the data used by him in his New York proposition. When the complete designs were ready, it was found by comparison that in the rough notes made by Mr. Reynolds while on his way east, he had arrived at identically the same dimensions of various parts as those obtained from the carefully worked out designs.—*Power.*

Semi-decennial Statistics—Iron and Steel Industries in the State of Maryland.

One of the results of the taking of the semi-decennial reports of the manufacturing industries of the United States is that the figures are likely to command much greater attention than they are when grouped for the ten-year periods, for the reason that they are shown for each State separately, and more attention can be given to each State, thus making the figures more valuable. Taking the returns for the State of Maryland we find that the iron and steel industries are third in importance of all the industries of the State. The number of establishments has remained the same during the past five years, namely, five, but the capital stock has increased from $2,892,690 to $7,128,091. While the number of wage earners employed has decreased from 2138 to 2092, on the other hand the wages paid have increased from $1,029,753 to $1,086,871. The items of miscellaneous expense also increased from $508,298 to $511,526, and the cost of material used from $6,888,916 to $10,206,558. There has also been an increase in the value of the output from $8,739,405 to $12,230,409. It must be remembered that these figures cover the returns for 7 steel works and rolling mills, and 2 blast-furnaces.

Turning the attention for a moment to the steel works and rolling mills we find that the cost of materials used has increased from $4,260,326 in 1900 to $6,582,085 in 1905. Of this total cost for materials 266,439 tons of pig iron were used in 1900 at a cost of $3,319,330; in 1905 343,424 tons were used at a value of $5,045,144. The quantity of scrap-iron and steel used in 1900 was 19,250 tons, at a cost of $311,087; in 1905 the quantity had increased to 47,527 tons at $653,660. The amount expended in these establishments for fuel and rent of power and heat increased from $223,362 to $377,613. There was an increase in the value of the output from $5,540,179 to $8,106,929.

The number of foundry and machine shops in the State are reported to be 98, and 5 for the manufacturing of stoves and furnaces, not including, however, those engaged in the manufacturing of gas and oil stoves. The number in 1900 was 113. On the other hand, the capital invested shows an increase from $6,381,676 to $7,523,033; the number of wage earners has decreased from 4695 to 4208, but here again there has been an increase in the wages paid from $2,251,777 to $2,556,664. Miscellaneous expense has increased from $456,175 to $1,155,689, while the cost of materials used shows a decrease from $3,322,658 to $3,098,470; and the value of the output shows an increase from $8,443,547 to $9,172,034. These industries combined stand fourth of all in the State in importance.

In addition to all the foregoing the statistics show that during 1905 there were 21 repair shops operated by the steam railroad companies in Maryland. In these shops 4977 wage-earners were employed, and the reported value of the product was $5,751,908. In the motive power and machinery department of the railroad shops the value of the work done was $2,917,555, as compared with $2,695,668 in 1900. The value of the work done in repairing locomotives amounted to $2,317,574 in 1905, as compared with $1,236,343 in 1900. In the car department the value of the work done in 1905 was $2,777,884, an increase of $976,243, or 54.2 per cent. over the amount reported for 1900.

Of the foundry and machine shops we find that 44 are under individual ownership, as against 54 in 1900. Twenty are under firm management as against 33 in 1900, while there has been an increase in the number owned by incorporated companies from 26 to 34. Of these establishments 15 show products of less than $5,000 each; 30 show $5,000 or over, but less than $20,000; while 37 show $20,000 and up to $100,000, while 16 show products valued at $100,000 or over, of which one is in excess of $1,000,000 annually.

Of the foregoing industries it was found that 7 of the shops for car, general shop construction and repairs on steam railroads are located in Baltimore, as are 63 of the machinery and foundry shops, also four of the stove and furnace plants, two for the manufacture of babbitt metal and solder, 1 for the manufacturing of steam railroad cars, 1 for firearms, 1 for chemical fire extinguishers, 1 for safes and vaults, two for gas and oil stoves and one type foundry. A. F. TENNILLE.

Washington, D. C.

Summer School for Artisans at the University of Wisconsin.

The sixth annual session of the Summer School for Artisans, held under the direction of the College of Engineering of the University of Wisconsin, begins June 25, and continues for a period of six weeks. The courses of study offered cover engines and boilers, applied electricity, mechanical drawing and machine design, materials of construction, fuels and lubricants, shop work, including forge work and bench and machine work in wood and iron, laboratory work and lectures for manual-training teachers. The requirements for admission do not extend beyond

a working knowledge of English and arithmetic. There is a uniform entrance fee of fifteen dollars and certain shop and laboratory fees. The entire outlay during the six weeks' term, including living and school expenses, is estimated at fifty dollars. A bulletin giving complete information may be obtained upon application to Frederick E. Turneaure, Dean, College of Engineering, Madison, Wisconsin.

The House Committee on Coinage, Weights and Measures has voted not to report favorably the Littauer bill for the adoption of the Metric system in the various departments of the Government.

Personal.

Dr. E. B. Van Vleck, professor of mathematics at Wesleyan University, where he succeeded his father who occupied the same chair for many years and is now professor emeritus, has been appointed to the similar chair at the University of Wisconsin.

Prof. W. D. Pence, head of the department of Civil Engineering of Purdue University, has been elected to the similar chair at the University of Wisconsin to fill the vacancy caused by the resignation of Prof. W. D. Taylor who has become chief of the Chicago & Alton Railway.

Business Items.

The Stanley-G. I. Electric Manufacturing Company has opened temporary offices at 102 Woodman Block, Oakland, California. Several carloads of electrical apparatus have already left Pittsfield to take the place of the machinery damaged or destroyed in the California distster.

The Toledo Machine and Tool Company, Toledo, Ohio, builder of bar and sheet metal working machinery and special tools, who recently moved into its new and commodious factory, has again been compelled by its increasing business to enlarge its plant, and arrangements have been completed for erecting a 200x100-foot addition, in which will be installed high-grade machine tools, electric cranes and all the labor-saving devices now known to the trade. A special department will be made in this new building for the manufacture of presses weighing up to 6000 pounds.

Catalogs.

P. Pryibil, 512-524 West Forty-first street, New York. Catalog C of power-transmitting machinery. Illustrated, 6x9, pp. 108, paper.

Curtis & Co. Manufacturing Company, St. Louis, Mo. Book No. 7, describing Curtis shingle specialties. Illustrated, 3x6, pp. 11, paper.

Sprague Electric Company, 527-531 West Thirty-fourth street, New York. Catalog No. 312, describing electric fans. Illustrated, 7x9, pp. 29, paper.

Elmira Machine Works, 208 College avenue, Elmira, N. Y. Circular illustrating and describing the Leader turret, which converts a lathe into a screw machine.

The New Era Gas Engine Co., Dayton, O. Catalog describing "Little Giant" gas and gasolene engines from 1½ to 30 horse power. Illustrated, 6x8, pp. 16, paper.

Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York. Catalog describing "Champion" automobile repair kit. Illustrated, 5½x8, pp. 27, paper.

The George Washington University, Washington, D. C. March, 1906. Catalog with announcements for 1906-1907, list of students, faculty, etc. 6x9, pp. 317, paper.

The Western Tool and Manufacturing Company, Springfield, Ohio. Circulars illustrating and describing the Champion expanding mandrels and portable vise stand.

Independent Pneumatic Tool Company, First National Bank Building, Chicago, Ill. Circular No. 6, describing and illustrating Thor pneumatic tools and appliances.

Niles-Bement-Pond Co., 111 Broadway, New York. Booklet illustrating electric traveling cranes for use in stone, freight, lumber, storage yards, etc. 6x9, pp. 19, paper.

Milton E. Hughes & Co., consulting engineers, 324 Dearborn street, Chicago, Ill. Pamphlet, entitled "Little Economies," which tells of the methods of this company. 4x9, paper.

Bath Grinder Co., Fitchburg, Mass. Catalog describing plain and universal grinding machines. A number of illustrations of different operations are shown. 6x9, pp. 40, paper.

Oneida National Chuck Co., Oneida, N. Y. Catalog of lathe and drill chucks. This is very neatly gotten up with stiff paper cover in imitation of cloth. Illustrated, 3½x6, pp. 52.

The Heald Machine Co., Worcester, Mass. Catalog describing cylinder grinders and ring and surface grinders. This has fine half-tone illustrations and is well printed. 6x9, pp. 24, paper.

C. W. Hunt Co., West New Brighton, S. I. Catalog 063 describing coal handling machinery for power stations, boiler rooms, gas companies, manufactories, etc. Illustrated, 6½x9½, pp. 60, paper.

Westinghouse Electric & Mfg. Co., Pittsburg, Pa. Special Publication No. 7043 describing electric fans and small power motors for direct and alternating current. Illustrated, 6x9, pp. 18, paper.

Ingersoll-Rand Company, 11 Broadway, New York. Catalog R 37, which describes Rand air and gas compressors. This contains a number of fine half-tone engravings, also various tables. 6x9, pp. 120, paper.

The Skinner Chuck Co., New Britain, Conn. Loose-Leaf Price List, made to fit No. 6 Morden's loose leaf price book. This also contains tables and information regarding line of chucks made by this company. Illustrated, 4x7½, pp. 31.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 64, entitled "Form I Motors and Generators," which describes the newly designed machines of this type and shows a number of applications to different tools. Illustrated, 8x10, pp. 16, paper.

Warren Webster & Co., Camden, N. J. Part I, Appendix II, of General Catalog, illustrating and describing "Star-Vacuum" feed-water heater, purifier, filter and receiver Class "E C", capacities 500 h.p. and larger. 6x9, pp. 32, paper.

Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass. Bulletin No. 603, illustrating and describing carbon-break circuit-breakers, types C-16, C-7, C-11. 6x9, pp. 20, paper. Circular No. 773, describing inner globes for all arc lamps. Illustrated, 3x5½, paper.

George V. Cresson Co., Philadelphia, Pa. Catalog entitled "Rope Driving", which describes the rope transmission system of this company. Fine tinted half-tone illustrations are shown, also diagram and table giving horse power transmitted by manila rope at various speeds, 6x9, pp. 19, paper.

Manufacturers.

The Bridgeport (Conn.) Crucible Company will build an addition to its plant.

The Cleveland (Ohio) Electric Illuminating Company is erecting a new power house.

Architect Francis M. Barton, Chicago, Ill., is preparing plans for a $120,000 foundry.

The National Manufacturing Company, Worcester, Mass., makers of wire goods, will erect a new factory.

The Northland Trade Company of St. Paul, Minn., will erect a cold-storage plant in Bemidji, Minn.

The Standard Roller Bearing Company, Philadelphia, Pa., will erect a new forge shop at a cost of $5000.

The Anderson (S. C.) Mattress and Spring Bed Company will enlarge its plant by adding another building.

The Colorado Fuel and Iron Company will spend over $4,000,000 in improving its steel plant at Pueblo, Colorado.

Contracts for the power plant for Warner & Swasey Company's new building at Cleveland, Ohio, have been let.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago, Ill.

Electrical apparatus designed and built. Geo. M. Mayer, 1131 Monadnock Bl., Chicago, Ill.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, N. Y.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Manufacturers of iron and wood-working machinery, machine shop and foundry equipment and supplies are requested to send catalog to the New London Marine Iron Works, New London, Conn.

Shop Organizer—Little defects in tools, product and shop organization consume profits. For a moderate outlay I will visit your factory and reduce your manufacturing cost to the minimum. Thirty years' experience. C. E. Tower, 1237 Monadnock Bl., Chicago.

Wanted—Manufacturers of hardware specialties, machinists' tools, mill and factory supplies of all kinds, who desire correct representation in Cleveland, Ohio, and adjacent territory, to correspond with us. The MacFarland-Snyder Co., 627 Rose Building, Cleveland, Ohio.

Trained men are in constant demand at high salaries. Our seven weeks' course fits you to drive, maintain and repair all gasolene cars. Day and evening classes. Inspection of building solicited. New York School of Automobile Engineers, 146 West Fifty-sixth street, New York.

"No-Chap" Hand Cleaner removes all kinds of grease and grime without injuring the skin. Will sell the formula with full instructions for making to but one person in every shop.

Sell it to your shop-mates and increase your income. Write for sample and price. W. S. Graham, Potsdam, N. Y.

Tool catalog No. 22, 930 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

For Rent.

Machine shop in Atlantic City for rent. Well fitted up for jobbing work; rent moderate. Apply 20 S. Tennessee avenue, Atlantic City, N. J.

Sub-Let—Brick warehouse, Bridgeport, Conn.; two stories and high basement, with elevator; 75x150 feet, on lot 100x150 feet; nearly opposite freight station, N. Y., N. H. & H. R. R. Present lease expires April, 1907. Address R. H. W., P. O. Box 1025, Bridgeport, Conn.

For Sale or to Rent—Brass foundry, Bridgeport, Conn., opposite freight station and within 500 feet of water-front. Property consists of 113.4 square rods. Main building, 60x200 feet, and equipped with crucible (21) furnaces, trolleys, etc.; fire-proof pattern safe, coreroom and supply sheds, stamp-mill and well yielding 200 gallons per minute. Location also valuable as warehouse. Address R. H. W., P. O. Box 1025, Bridgeport, Conn.

For Sale.

For Sale—Foundry, wood and iron machine shops, Albion, N. Y. Box 74.

For Sale—Full automatic 60-inch gear cutter, in first-class condition. Box 1759, Pittsburg, Pa.

For Sale—10-h.p. Knox gasoline engine for automobile or stationary purposes. Price, $75.00. Box 1171, Springfield, Mass.

For Sale—Bound volumes AMERICAN MACHINIST, 1880-1900 inclusive. Splendid condition. Box 419, AMERICAN MACHINIST.

For Sale—Drawings, patterns and finished parts for 3 and 4-cylinder four-cycle marine engines, modern design, with latest improvements. Box 498, AMERICAN MACHINIST.

Business Opportunities.

I have a modern shop; also some cash. Can offer good chance to skilled machinist who has money and wants to get into manufacturing. If he has some good specialties, better still. Box 517, AMER. MACHINIST.

Manufacturer's Opportunity—To a well-equipped machine shop with $100,000 capital I can bring the opportunitty to manufacture one of the best special lines connected with building industry for which there is constant and profitable demand, and upon which I have secured a number of patents. Address Box 523, AMERICAN MACHINIST.

Wanted—High-grade engineering salesman to manage a department for well-known machinery houses in New York. Fine opportunity and attractive salary for man of exceptional ability who can show results. Must be thoroughly familiar with territory and be in position to invest from $2000 to $5000. In writing, give full details as to previous record and present salary and position. Address "Engineer," 434, AMERICAN MACHINIST.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Position as superintendent or works manager of plant manufacturing automobiles or gas engines; competent to plan works, select machinery, arrange shop system and organize working force. Address Box 519, AMERICAN MACHINIST.

ILLINOIS.

Wanted—Position as general foreman or superintendent of manufacturing plant or machine shop. Have had wide experience and can give good references; am not open to any but firms of good standing. Box 515, AMERICAN MACHINIST.

IOWA.

Chief draftsman; a mechanical engineer, at present chief draftsman with a large manufacturing concern in the West. Box 269, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical engineer experienced on special and automatic machinery desires responsible position. Can develop special cost-reducing machinery. Box 510, AMERICAN MACHINIST.

MICHIGAN.

Chief Engineer of 4000-horse-power steam electric plant, cross-compound engines, mechanical stokers, etc., wants to change. Excellent references and satisfaction guaranteed. Box 423, AMERICAN MACHINIST.

Factory manager and graduate engineer experienced in handling both office and shop to produce results; systematizer and practical accountant; desires change to new and growing concern. Box 502, AMER. MACH.

NEW JERSEY.

Works manager or superintendent, located near New York City, will be open for position by June 1. Box 516, AMERICAN MACHINIST.

All around mechanic, 29, technical education, 6 years at drafting, extensive experience in designing and making special machinery, tools and fixtures for modern manufacturing, desires change, either shop or office, with chance for advancement. Box 505, AM. M.

NEW YORK.

Position as draftsman—Some experience, 2 years in shop; salary moderate. Box 479, AMERICAN MACHINIST.

Chief Draftsman, specialist on automatic machinery; broad general experience; practical mechanic; technical. Box 527, AM. M.

Mechanical draftsman (23), four years' experience, wishes to change; will go out of town for good position. Box 521, AM. MACH.

General foreman (36), responsible man, practical mechanic, successful in producing first-class work at satisfactory cost, varied experience, desires change. Box 482, AM. M.

Chief Draftsman desires change; energetic and executive; capable designer of machinery and mill construction; experienced in directing shop work. R. W., Box 501, AM. M.

Position as superintendent or general foreman in plant manufacturing steam, marine, gas or gasoline engines; general mill machinery; fine grade automatic machinery. Box 462, AMERICAN MACHINIST.

Draftsman and designer, 30, technical education and 9 years' experience on apparatus, jigs, fixtures, experimental work and developing special machinery. Responsible and active man. Box 484, AM. M.

Machinery salesman and mechanical engineer, age 27, talks German, 3 years' experience city and vicinity, familiar sales management and office methods, desires permanent similar position. Box 506, AMER. MACHINIST.

Expert tool designer and master mechanic desires change. Age 36; high grade and accurate work, jigs, fixtures, tools, gages and automatic machinery for duplicate parts; A-1 references; would take charge of factory or large tool room. Box 511, AMER. MACHINIST.

Business Representative and Engineer—I have had successful experience as chief salesman of home office and manager of two outside offices (same company); territories being East, Middle West and Southwest. Am now consulting engineer improving machinery product for manufacturing company having headquarters in New York City. I desire to change work of broader activity and solicit a position as business representative where engineering experience is useful. Address Box 524, AMERICAN MACHINIST.

OHIO.

Young, energetic man, holding responsible position with concern in which he owns stock, desires change. First-class references given and required. Box 528, AMER. MACHINIST.

Mechanical engineer, 37, thorough practical experience in shops and drafting room, technical, executive ability and commercial training desires correspondence with firms having prospective openings. Box 522, AM. M.

PENNSYLVANIA.

An experienced machine blacksmith desires situation as foreman, can handle men and work to best advantage. Box 529, AM. M.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Draftsmen experienced on fixtures and dies for light interchangeable work. Address giving details of experience and expectations. Box 514, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Coremaker foreman for large foundry in New England. Good salary to man capable of handling 75 coremakers on high-grade work. Give full particulars as to age, experience, references, salary desired and class of work most familiar with. Box 410, AM. MACHINIST.

DISTRICT OF COLUMBIA.

Wanted—Master machinist, $6 per diem. A competitive examination will be held for the above position May 15, 1906. For further information address "Commandant, Navy Yard, Portsmouth, N. H."

GEORGIA.

Wanted—Two or three each, Gisholt and Jones & Lamson turret lathes, second-hand. DeLoach Mill Mfg. Co., Atlanta, Ga.

Wanted—A superintendent for a plant employing 300 men, manufacturing steam engines, saw mills, and wood-working machinery. Must have a thorough technical education, as well as a practical knowledge of the business, including the foundry and modern moulding machine practice. Address M. M., 466, AMERICAN MACHINIST.

ILLINOIS.

Wanted—Man of business experience and recognized standing as engine expert to take charge of gas-engine development for large manufacturing company. Box 403, AM. M.

Factory superintendent wanted in gasoline engine factory, located in Central Illinois. One who can get out the work and reduce cost. Address, Havana Manufacturing Co., Havana, Ill.

Wanted—General foreman for large shop making special machines. Only high-class, practical, experienced man of executive ability, who is holding similar position, will be considered. Requires man fully capable of handling 300 to 400 men. State if experienced in foundry work. Excellent opportunity. All communications held strictly confidential. Box 421, AMERICAN MACHINIST.

Required for a small arms factory abroad, an educated engineer with experience of very high-class interchangeable work produced by the latest automatic and repetition methods. Must be active, energetic, thoroughly at home in jig and fixing work and up to date generally. Write fully as regards experience and salary expected, also stating age, etc. Box 520, AMERICAN MACHINIST.

IOWA.

Manager for old-established plant, manufacturing engines and mining machinery. Must have up-to-date methods and thorough mechanical knowledge along with business ability to take full charge of plant. Fine opportunity for the right man at good salary. Please give age and general experience in first letter. A. B. C., 463, AMER. MACHINIST.

MASSACHUSETTS.

Wanted—Draftsmen; two reliable and experienced men on web printing presses and kindred machinery; applicants must state age, experience and terms. Box 453, AM. M.

Wanted—At once, several jig makers and scraper hands. We can offer good wages and permanent positions to the right men. Apply Campbell Printing Press Mfg. Co., Taunton, Mass.

Wanted Two first-class toolmakers; pleasant shop and surroundings. For steady, capable men positions will be permanent. In answering state age and experience, if married or single, and wages expected. Factory twenty miles from Boston. Box 518, AM. M.

Wanted—Several young men for installers in New England for delicate automatic machinery. Experience in construction, assembling or installing such machinery is essential. State age, wages required, previous experience and give references. Box 503, AMERICAN MACHINIST.

MICHIGAN.

Wanted—First-class machinist to act as instructor in gasoline-engine factory, machine dept. Must be a hustler. State age, experience and wages. Box 468, AMER. MACHINIST.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center, and is one of the finest

cities in this country. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern up-to-date methods. Competent men who are experienced and will "do things right" can secure permanent employment at first-class wages. State age, experience, references, wages, and give full information. Cadillac Motor Car Co., Detroit, Mich.

MINNESOTA.

Wanted—First-class machinists, moulders and pattern-makers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel & Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Wanted—Detail draftsman for construction work around large plant; state age, experience, salary expected, etc. Box 512, AMERICAN MACHINIST.

Wanted—First-class lathe and vise men for small steel work. Steady work, good pay, no trouble. Twenty-five miles from New York City. Box 194, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—Foreman accustomed to production of light interchangeable work; must also be good toolmaker, fully conversant with light experimental work, and accustomed to handling help. Address Box 429, AM. MACHINIST.

NEW YORK.

First-class mechanical draftsmen desired; state age, experience and salary expected. Box 507, AMERICAN MACHINIST.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Mechanical engineers and first-class draftsmen, with experience in designing for general railroad work. State full particulars, also salary required. Box 504, AMERICAN MACHINIST.

Wanted—Chief draftsman of wide experience on web printing presses. Excellent opportunity. State age, experience, and salary desired. All communications held strictly confidential. Box 476, AMER. MACHINIST.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hours work day; time and a half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

We are permanently increasing our capacity and require the services of twenty mechanical draftsmen for detail work, and fifteen tracers. Location, New York City. State age, experience and salary expected. Box 526, AMERICAN MACHINIST.

Stenographer Wanted — Young man, one who has had experience in mechanical correspondence; good, steady position in pleasant surroundings to right person. Write giving full particulars as to experience, references, age and salary expected. Address Supt. The De Laval Separator Co., Poughkeepsie, N. Y.

Metallurgist Wanted—With practical experience in selection and testing of iron and steel for use in manufacturing of small machine parts; must be familiar with best practice in heat treatment and able to draw specifications securing best machining qualities consistent with given physical properties. A technical graduate capable of making accurate chemical analysis preferred. Thorough knowledge of tool steels desirable. Box 467, AMERICAN MACHINIST.

OHIO.

Gisholt operator wanted, to take charge of several lathes on contract work. Address Box 525, AMERICAN MACHINIST.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 455, AMERICAN MACHINIST.

The National Metal Trades Association can place a few first-class wood pattern-makers, tool makers and all-around machinists. Highest wages, and steady employment guaranteed. Address with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, Ohio.

Wanted—First-class man to take charge of designing of up-to-date jigs and fixtures for machine-tool work. Must be capable of giving instructions in use of the same. None but parties having practical shop experience need apply. State experience and salary wanted. Address Cincinnati Milling Machine Co., Cincinnati, O.

PENNSYLVANIA.

Wanted—Good toolmakers and machinists, familiar with Government work. Box 451, AMERICAN MACHINIST.

Foreman, experienced in all branches of gear cutting, to take full charge of twenty-six machines. Box 513, AMERICAN MACHINIST.

Wanted—Several first-class scrapers, also planer and lathe hands, for machine tool work. Address Colburn Machine Tool Company, Franklin, Pa.

Wanted—Foreman accustomed to rapid production of interchangeable work; must be energetic and accustomed to handling help. Reply, giving full experience, present occupation and salary expected. Box 499, AM. M.

Wanted—A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motor preferred. Only first-class men need apply. Address Chief Draftsman, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa. (P. O. Box 911.)

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: character, common sense, experience with automatic machinery, (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

VIRGINIA.

Wanted at once, good draftsman on power plant and blast furnace work. Would get some outside work if competent to do it. Technical graduate preferred. Salary $100 per month for good man. Address "Longdale," 469, AMERICAN MACHINIST.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Unusual opportunity for a man with mechanical ability to work into a position of responsibility. Must be energetic, tactful, and a good executive, capable of handling men, and a good machinist. Plant located in Wisconsin. Reply, giving full experience, present occupation and salary desired. Box 509, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—A young, energetic machine-shop foreman, up-to-date in modern practice in manufacturing; also a man who knows how to take advantage of jobbing business, by a strictly open shop in Seattle, Washington. Line of manufacture: fire hydrants and water-works goods. Could use two or three other good mechanics in the line. Box 500, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	163
Acme Machinery Co.	34
Adams Co.	118
Advance Mfg. Co.	143
Albro-Clem Elevator Co.	169
Alliance Machine Co.	186
Almond Mfg. Co., T. R.	142
Alteneder & Sons, Theo.	34
American Blower Co.	126
American Gas Furnace Co.	123
American Pulley Co.	132
American Tool Works Co.	8
American Tube and Stamping Co.	173
American Watch Tool Co.	124
Armstrong Bros. Tool Co.,	117 and 187
Athol Machine Co.	159
Atlas Machine Co.	168
Auburn Ball Bearing C.	158
Audel & Co., Theo.	154
Automatic Machine Co.	172
Backus Water Motor Co.	160
Badger & Sons Co., E. B.	161
Baker Bros.	128 and 159
Baker Machine Corp.	154
Baird Machinery Co.	165
Baldwin Chain & Mfg. Co.	169
Baldwin Steel Co.	91
Barnes Co., B. F.	129
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E.	102
Bath Grinder Co.	99
Baush Machine Tool Co.	176
Bay State Stamping Co.	168
Bay State Tap & Die Co.	169
Bay State Tool Co.	173
Beaman & Smith Co.	15 and 142
Becker-Brainard Milling Machine Co.	23
Bemis & Call Hardware & Tool Co.	128
Bertram & Sons Co., John	174
Bertsch & Co.	135
Besly & Co., Chas. H.	125
Bethlehem Fdry. & Mach. Co.	138
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	186
Bilgram, Hugo.	34
Billings & Spencer Co.	100
Binsse Mach. Co.	34 and 122
Birdsboro Steel Fdry. & Mach. Co.	31
Blaisdell Machinery Co.	140
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	131
Boker & Co., Hermann	89
Boston Gear Works	149
Boyer Bros.	98
Boynton & Plummer	132
Bowers, E. J.	163
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	128
Brickner Machine Co.	159
Bridgeport Safety Emery Wheel Co.	127
Bristol Co.	4th cover
Brown Co., H. B.	166
Brown-Cochran Co.	160
Brown & Co., R. H.	142
Brown Hoisting Machine Co.	185
Brown & Sharpe Manufacturing Co.	4th cover and 79
Buckeye Engine Co.	138
Buffalo Forge Co.	4th cover & 176
Builders Iron Fdry.	3d cover
Bullard Machine Tool Co.	32
Burke Machinery Co.	134
Burr & Sons, John T.	170
Bury Compressor Co.	140
Butler, A. G.	143
Byram & Co., Inc.	158
Calculagraph Co.	167
Caldwell & Son Co., H. W.	147
Carborundum Co.	20
Card Mfg. Co., S. W.	24
Carpenter Tap & Die Co., J. M.	124
Case Mfg. Co.	187
C & C Electric Co.	179
Chadwick & Co., G. B.	162
Chambersburg Eng. Co.	169
Champion Tool Works.	173
Chattanooga Machinery Co.	163
Chicago Flexible Shaft Co.	122
Chicago Rawhide Mfg. Co.	150
Chisholm & Moore Mfg. Co.	187
Cincinnati Electrical Tool Co.	173
Cincinnati Machine Tool Co.	20
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	27
Cincinnati Shaper Co.	190
Clark Cast Steel Cement Co.	173
Clayton Air Compressor Wks.	140
Cleveland Automatic Mach. Co.	18
Cleveland Cap Screw Co.	128
Cleveland Crane & Car Co.	186
Cleveland Fillet Co.	147
Cleveland Planer Works.	113
Cleveland Twist Drill Co.,	4th cover and 105
Cleveland Wire Spring Co.	129
Cling-Surface Co.	172
Clough, R. M.	150 and 165
Coates Clipper Mfg. Co.	156
Cochrane-Bly Co.	111
Coes Wrench Co.	28 and 29
Colburn Machine Tool Co.	22
Columbus Machine Co.	160
Cook Co., Asa S.	160
Crescent Forgings Co.	171
Cresson Co., Geo. V.	143
Crocker-Wheeler Co.	184
Cullman Wheel Co.	154
Cumberland Steel Co.	165
Curtis & Co. Mfg. Co.	140
Curtis & Curtis Co.	162
Cushman Chuck Co.	142
Davis, Rodney	150
Davis Machine Co., W. P.,	103 and 164
Dayton Machine & Tool Wks.	171
Dayton Pneumatic Tool Co.	140
Desmond-Stephan Mfg. Co.	162
Detrick & Harvey Mach. Co.	172
Dexter, Chas. S.	150
Diamond Chain & Mfg. Co.	136
Diamond Machine Co.	3d cover
Dickinson, Thos. L.	162
Diehl Mfg. Co.	182
Dill Machine Works, T. C.,	91 and 164
Dixon Crucible Co., Joseph.	135
Dodge & Day	160
D'Olier, Jr., Co., Henry	109
Dreses Machine Tool Co.	178
Drucklieb, C.	140
Durbrow & Hearne Mfg. Co.	138
Dwight Slate Machine Co.	152
Earle Gear & Mach. Co.	140
Eastern Machinery Co.	161
Eberhardt Bros. Mach. Co.	163
Eck Dynamo & Motor Works.	182
Elliott Chemical Works.	161

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Stay-Bolt Threading and Turning Machine.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show a stay-bolt threading and turning machine with its special die head, which is the invention of C. K. Lassiter, of the American Locomotive Company, by which company it is largely used. The machine produces bolts having a reduced center portion in accordance with the best modern practice as shown in Fig. 1. The bolt blanks are first cut to length and have a square head forged on one end as shown, after which they are completed by the machine in a single operation.

Fig. 2 shows the machine complete from which it will be seen that the blanks are driven from below by a simple square hole chuck in which the blanks are inserted while the machine is in motion. The die head—shown more fully in Fig. 3—has a pair of wings with holes which slide on guide rods. Overhead is a constantly revolving shaft with flanged pulleys over which straps hang, one end of each strap being connected to a die head, while the other has a handle which when pulled after the die has been opened lifts it with slight effort on the part of the operator. With the die elevated, the finished bolt is removed and a fresh blank is inserted, after which the die is lowered and the threading and turning are repeated. As the die rises a latch is engaged which closes the chasers, and on the completion of the cut, a second latch is operated to open them. The operation is thus automatic except for inserting and removing the work and, with six spindles to a machine, the operator is keep well occupied. The main feature of the machine is, of course, the die head. The chasers are of high-speed steel and are made by a special process, which the inventor does not disclose, and by which he claims that threads of a high degree of accuracy of pitch are obtained, and certainly some of them which were examined bore out the statement.

The die heads also carry a pair of round-nosed turning tools in the rear of the chasers by which the central reduction is made. The chasers cut a thread the full length of the bolt, thus insuring that the second end shall be a true continuation of the first, the turning tools removing part of this thread after it has been cut. The turning tools are operated by stationary bars secured to the frame of the machine and passing through wings on the die head as shown in Fig. 3. The bars carry cams by which the tools are forced in and withdrawn at the proper points of the bolt's length, cams being provided for the various lengths of bolt to be made. The setting of the turning tools is by a gage plug which is inserted in a suitable recess in the die-head body.

The vertical position of the work gives excellent facilities for lubricating the tools and the die head carries on its upper side a funnel down which a stream of oil flows to flood the tools. F. A. H.

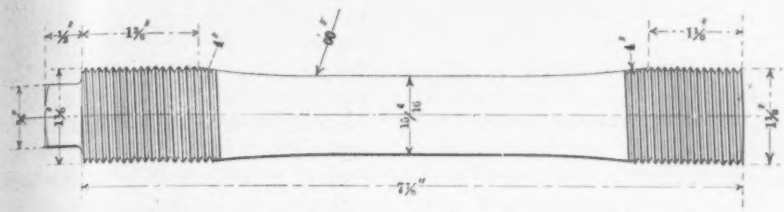

FIG. 1. FORM OF STAY-BOLT PRODUCED ON THE LASSITER MACHINE.

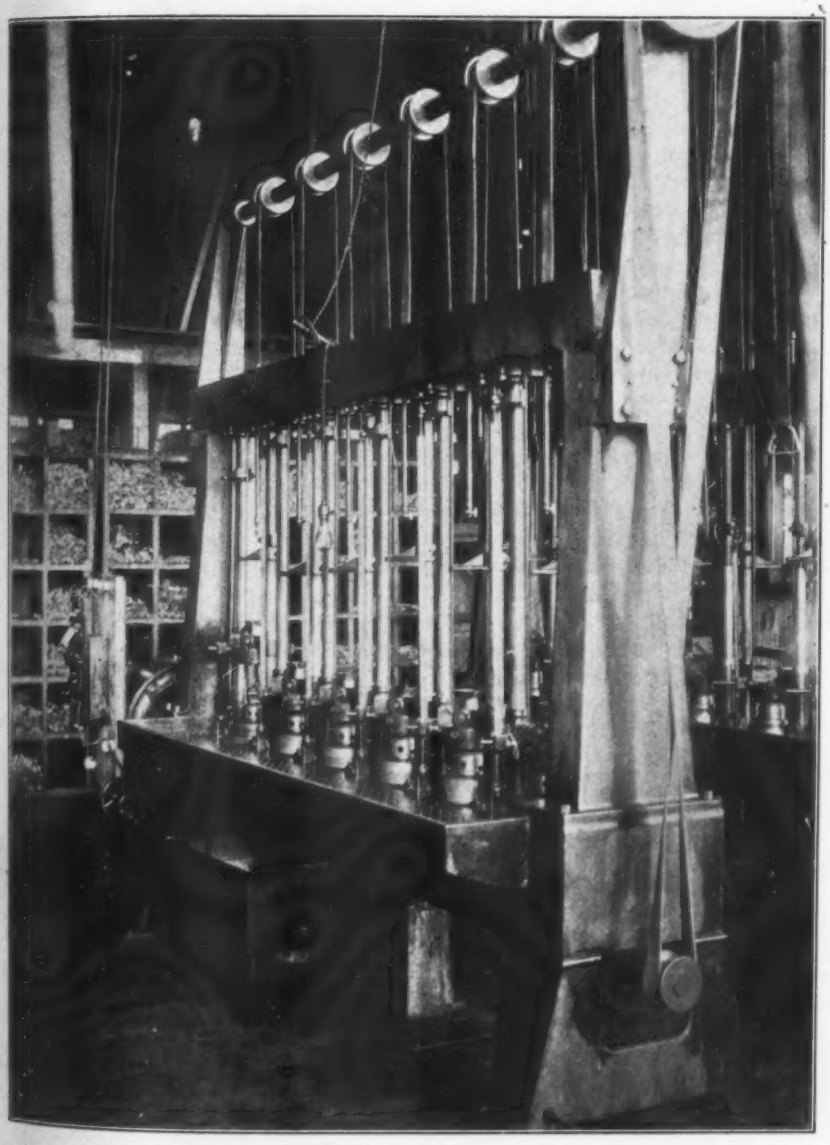

FIG. 2. THE LASSITER STAY-BOLT THREADING AND TURNING MACHINE.

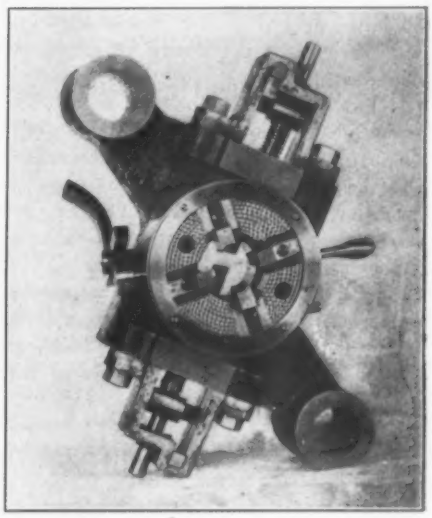

FIG. 3. THE LASSITER DIE HEAD.

A method of generating actylene gas by shaking calcium carbide up with dry soda crystals may supersede the present method.

What is Going On in Some of the Shops of the Middle West—I.

One of the observers who occasionally go out from this office to see how machine shops are looking, how the people who own and operate them are feeling, and what they are thinking about, took a trip recently through what we now call the Middle West, and in executing a flank movement upon Cincinnati, found himself at a certain railroad station in Hamilton, Ohio, near the works of the Long & Allstatter Company, and with about an hour of time before dinner would be served at the palacious hotel; such as one generally finds in small towns, 20 miles or so from a much larger one, and with good train service between.

THE LONG & ALLSTATER COMPANY.

Mr. McBeth was found on duty in the office where he was discussing with a visitor the terms of conveyance of some property designed to be used as an addition to the effective capacity of the works, and this proved to be typical of what was going on in practically all the works visited in that section of the country.

Not only was it found that the volume of business of the Long & Allstatter Company has very much increased, but also the average size of machines built is much larger than formerly. On the floor at the time was a 12-foot punch, that is, a punching machine with a so-called gate 12 feet long and to which may be attached apparently innumerable punches. The frame of this machine has three housings, and there are four eccentrics on the shaft with suitable connections to the gate. Many other very large machines were in course of construction for the Cambria Iron Works, The Illinois Steel Works and the American Car & Foundry Company. The frame of one of the machines referred to was a single steel casting weighing 43,000 pounds, and for this, or a similar machine, there was a crank shaft of nickel steel, 18 inches in diameter, which shaft in this case had been supplied, rough turned, by the concern for whom the machine was being built.

Mr. McBeth said he was expecting that afternoon some visitors representing one of his best and largest customers, who were coming to see why better deliveries could not be made, and there had been an intimation that orders would be cancelled unless deliveries were made immediately. Mr. McBeth seemed not to be much worried about that, however, for said he, I can readily show these men that we are doing the best we can, and I know also that few, if any, of our competitors can make better deliveries.

NILES TOOL WORKS.

At the Niles Tool Works, after a little talk with Mr. Cullen, chiefly on the subject of cost keeping with reference to maintenance of prices, the visitor was shown through the shop by one of the old veterans, F. W. Brunning, who has been with the concern for many years, and is now one of its inspectors.

Not far from the office door there stood in a row four completed 300-ton driving wheel presses, and in reply to an inquiry Mr. Brunning said they now turn these out in lots of six usually. I reminded him of a time when the building of one such press would have been considered a somewhat notable achievement for the works, and he said, "Oh yes, in those days when such a press was completed, we would all knock off to see it shipped."

Among the other notable things on the floor was a 30-inch boring bar which is being made for a boring machine originally built here for the Connersville Blower Works, this bar being intended for boring the cylinders of such rotary pumps as we recently published illustrations of. The bar is 22 feet long, of cast iron, hollow and ribbed internally for the purpose of getting the utmost possible rigidity. Such a bar cuts quite a figure, even upon the floor of the Niles Works, where large and heavy work abounds on every hand.

Among the other jobs being finished were two gun lathes for the Japanese Government, and in every department it was manifest that efforts were being made to turn out all the work possible in order to fill orders within a reasonable time.

AMERICAN TOOL WORKS.

At the American Tool Works Company's place, with J. B. Doan and Mr. Robinson as guides, similar efforts to get out work up to the full capacity of the place was noted, and also it was evident that the present demand for heavy cuts was having its effect upon designs. For instance, a 28-inch shaper was shown capable of taking a cut ½ inch deep, with a 5/32-inch feed in cast iron. In former days it was considered sufficient in building such tapers to cast or bolt a sleeve bearing to the side of the column in which was journaled the shaft supporting the main driving gear and crank; the side of the column itself being usually without reinforcement. With such heavy cuts as the one mentioned, however, it has become increasingly necessary to so rib and thicken the side of the column as to prevent springing and to show how much springing might take place under a heavy cut, and how nearly such springing had been eliminated in a machine of new design, Mr. Robinson had attached to the end of the crank shaft projecting at the side of the machine an indicator four feet long, having at its outer end a pointer accurately centered and made true when the shaper was running without a cut and so arranged as to show by its eccentricity the amount of spring taking place with a heavy cut. The experimenter was not able to say definitely how much spring was indicated, but at least it is evident that this was a good and practical way of acquiring precise knowledge of the extent of spring that did take place, and the result has been entirely satisfactory.

A good many geared-head lathes are being built here and one of 24-inch swing arranged to be either motor or belt driven, is capable of turning 15 point steel at the rate of 55 feet per minute, with a cut ½ inch deep, with 1/16-inch feed, the lathe requiring to drive it at this rate 9 h.p.; which would probably have been ample power for driving 10 lathes of this nominal capacity, only a few years ago.

Noting the number of jigs and special fixtures used in this shop in the manufacture of machine tools, in reply to a question, Mr. Robinson said it was their custom to charge off 20 per cent. of the cost of such jigs and fixtures each year, so that in five years they were supposed to have them paid for. While it is true that some of them have a longer life, others have shorter ones, and it is probable that five years represents the average service of such fixtures in these days of rapid advance in machine-tool design and the necessity for discarding older designs and the fixtures for producing them.

Some discussion of the maximum speed practicable to run planers when using high-speed steel tools took place and it was stated that, all things considered, it was found best not to run planers for any purpose above 40 feet cutting speed. I found a number of shops in which, as a result of considerable experience, this speed had been determined to be about the highest practicable.

Saw-tooth clutches are used a good deal in the product of this shop, and, discussing the action of some of them, Mr. Robinson said they had discovered a thing which he believed was quite generally overlooked by those who made them. Where such clutches are made with the driving faces parallel with the axis, that is to say, radial so that the faces of the teeth lie in radial planes, they may be cut in the ordinary way, but it is quite the common practice to incline these faces backward a little, so as to make them release a little easier and give a better action. Where this is done, Mr. Robinson called attention to the fact that the faces of the two parts of the clutch will not fit each other, if it is attempted to mill them without rotating the clutch; in other words, the surface when it is inclined in that way must be helical in order to secure contact over any considerable portion of the teeth. They mill them by gearing up a milling machine to produce a helix with a long pitch, and thus get good contact and good wearing qualities, which are otherwise not obtainable.

As a result of experience in their own shops and in those of their customers, this firm has somewhat simplified the

later designs of their radial drilling machine, giving it as their opinion that in practice the extreme speeds and feeds are not desirable and do not in the end produce as good results as where a little more moderation is employed. For instance, they find that in drilling the holes in a planer bed 36 inches by 12 feet, and using a 31/32-inch drill, a feed of 0.012 inch per revolution with a cutting speed at the periphery of 80 feet per minute, gives the best results; it being taken into consideration that at this rate the entire planer table can be finished without change of drills.

CINCINNATI MILLING MACHINE CO.

At the works of the Cincinnati Milling Machine Company they are always experimenting, with a view to finding out more things about the working and the construction of milling machines, and have lately been applying electrical instruments to measure the amount of current required to drive their own and other machines, and noting the power transmitted through the driving mechanisms to the milling machine arbor; measuring it there by means of a prony brake. They have gotten some interesting results, which, however, are not as yet ready for publication. Their own present opinion seems to be that the best results are obtained by the use of a variable-speed motor, with a rheostat. With such an arrangement on a machine in their own shop they are getting 51 speeds with the rheostat, and by the motor 3 speeds on each point of the rheostat, making a total of 153 speeds. The speeds are found to be very definite, and they get steps from one speed to the next of from 2 to 3 turns per minute in the medium speeds and from 3 to 5 turns per minute in the higher speeds.

One of the most interesting things to be seen in this shop is what they call a pneumatic chuck, which has been designed for holding work upon the platen of the miller and for very quickly fastening or releasing the work. It consists of a base, forming the surface upon which the work rests, and within which are six cylinders 3¼ inches diameter, the length of the chuck being about 28 inches. With 80 pounds air pressure, little pistons in these cylinders are forced outward and, being connected to the jaws by means of small links and levers, they give a pressure upon the jaws of 3000 pounds. By merely turning a stop cock all the jaws are simultaneously and instantly tightened; maintenance of the air pressures insures that the work will be held with a constant grip throughout the operation, and it is, of course, very firmly held. The importance of some such fixture became apparent with the increased speeds and feeds used in milling work, the time required for putting in, fastening and releasing the work becoming in that way a very considerable percentage of the total time consumed on the job.

Some milling chips shown me in this shop were very impressive, but would not, I think, be taken by most shopmen for anything other than lathe or planer chips. The chips were of cast iron, had been made by a spiral cutter, 2¾ in. in diameter, having twelve teeth of 9/16-in. pitch, nicked, the cutter being of Novo steel. The speed was 100 ft. per minute, with a feed of 0.3 inch per turn; width of the cut was 2¼ in. and its depth about ⅛ in., which means that the work was being milled at the rate of 30 linear, or 67.5 sq.in. per minute. If these figures fail to convince one that the milling was being done at a fast rate, a glance at the chips would certainly do it.

Noticing some inspectors' test sheets, which appeared to be rather formidable, I asked for copies of some which had been filled out. An examination shows that on their No. 3 Universal milling machine there is a total of 42 entries on the sheet; 26 of these are points which are to be looked after in respect of finish, accuracy or smooth working of the machine, but in which the limit of error is not stated in definite figures; while in the other 16 of the entries the maximum errors allowable and the direction in which the error is allowed (where this makes any difference) is stated in thousandths of an inch. Every one of these entries must be filled in by the inspector, and where there is a departure from exactness he must state the amount of the variation, which, of course, must be within the limit allowable. This is exclusive of the dividing head which is separately inspected, and on the test sheet of which there is a total of 27 entries, 16 of which do not require the entering of the amount of variation, while the other 11 do; the maximum allowable error being stated for these as for the machine itself.

Charles R. Gabriel, who has recently taken charge of the drafting-room of this company, was found engaged in the work of reorganizing its methods somewhat, and among other things is establishing a "fire record" of drawings, which consists of blue-prints, one of which is made from each drawing and stored in a fire-proof vault. For the patternmakers, blue-prints are made, and the patternmakers' figures are then independently marked upon these blue-prints. This Mr. Gabriel thinks is much preferable to confusing the regular drawing with the patternmakers' figures which are of no interest after the patterns have once been made, and are of no importance as matters of record, because in case a second pattern is to be made, they may be easily marked upon another blue-print.

THE CINCINNATI SHAPER COMPANY.

The new shops of the Cincinnati Shaper Company were found quite full of work, among which were six side shapers, of the Richards type, with the incorporation of very advanced ideas respecting the arrangement of guiding surfaces, traversing screws, etc. A number of these had been sold before their completion, and the members of the firm believe that there will be a good demand for them. In this shop they have their work thoroughly well systematized, and the shops well equipped with special fixtures. Among other details were noticed boxes of bolts, clamps, etc., selected and arranged for given jobs; so that, for instance, a man having a lot of a certain part of the shapers to plane up, can go to the tool room and in a box by themselves will be the bolts and clamps that will be just right for the work he has in hand. Anyone with much shop experience knows how much time this saves in hunting for such things, during which hunting time, the planer, of course, stands idle, to say nothing of the time lost by the man himself.

A special device for milling the outer bearing or support for the knee attracted attention. It is becoming quite the fashion to provide these supports, and the belief in this shop is that if such a support is put on, it should be accurately in line with the cross rail of the shaper, and so they arrange a milling fixture to be attached to the knee itself, and after the shaper is all erected and the knee fitted to the cross slide, this milling is done by traversing the knee itself; so that the milled surface of the rest is bound to be precisely in line with the cross-rail guide. Very refined methods of securing absolute squareness by means of indicators are also employed.

In the stock room is a large blackboard, on which an account of stock is kept in such a way that the stock-keeper at a glance, and from almost any position in the room, can tell the condition of the stock with regard to any piece composing a regular product of the concern. The

MUELLER MACHINE TOOL COMPANY

was found very busy, building the radial drilling machines which were illustrated in our columns a while ago, many of them being for shipment abroad. And at the works of

SCHUMACHER & BOYE

much the same condition existed in respect to lathes. Here they show you a lathe which is of about 20-inch swing, and in which, using two tools, one in front and one at the rear, a piece of 20 point carbon steel, four inches in diameter, has been reduced to 1⅝ inch diameter, with a feed of ⅛ inch, and at a cutting speed of 130 feet per minute. The shops of the

BICKFORD DRILL & TOOL COMPANY

are so busy and crowded as to be difficult to pass through between work and workmen. They were preparing for an additional space for which they have acquired land from adjoining property, and which, when it is in commission, will enable them to make deliveries within a

more reasonable time, or at least that is hoped to be the case. The

JOHN B. MORRIS FOUNDRY COMPANY,

the concern which has been supplying most of the castings for the machine tool builders of Cincinnati, has itself finally gone into the business of building machine tools and has acquired the radial drill business of Roos & Mill.

Though the foundry is, of course, still by far the largest end of their business, it is expected that the machine-tool end of it will grow under the mechanical supervision of Mr. Schellenback. At the

BRADFORD MACHINE TOOL WORKS

engine lathes were being turned out to the full capacity of the place, and the superintendent, Mr. Johnson, believes that this capacity is higher than it otherwise would be within the same shop, by reason of the method followed in dealing with the men, foremen, apprentice boys etc. Pointing out a number of young fellows working at machine tools, he gave the wages made by these boys, which certainly were very much higher than the ruling figure. Mr. Johnson, however, said that he believed that this paid, and paid well. The boys were the best to be had, and they were satisfied that they were doing as well right there as they could do anywhere else, if not a little better; he believed they were worth more to him than they would be to any other shop at least until they had had time to become as well acquainted with the new work, and he could afford to pay them well. He expressed himself as being convinced that the main secret of successful shop management was to deal liberally with employees; giving as an instance his arrangement with a man who one day expressed the opinion that he could arrange to save considerable time in making lathe-carriage aprons. The man was told that if he could do so, he could have the benefit of all the saving. This is still being paid to him, Mr. Johnson expressing the belief that it pays the shop, and pays well to do this and to have the men understand that it will be done in such cases.

In this shop they have a very unusual key seater or milling machine, designed and built by themselves for the purpose of splining the feed rods used in their lathe. These, as we all know, are a long and rather slender rod, and instead of attempting to support the rod in V-bearings and clamp it solidly, it is simply passed through rollers, which are in effect feed rolls with V-surfaces in which the rod rests and is fed, there being perhaps small corrugations in some of the rolls, in order to prevent slipping. A milling cutter between the two pairs of rolls does the milling, and in one of the rolls which receives that part of the rod which has been already splined, there is a tongue which fits into the milled groove and thus prevents rotation of the rod while being milled. There is thus no limit to the length of work the machine will mill, and yet it is a small machine. It has been in operation for some years and seems in every way satisfactory and efficient.

In the office of the

G. A. GRAY COMPANY

George Marks, in reply to a question, said he thought there was nothing that would be new to me in the shop, yet we had no more than gotten outside the office door until something was seen which looked to be entirely new. A planer stood there ready for shipment, and instead of being merely slushed, it had first been slushed in the ordinary way, and then covered with large sheets of a combination of tarred paper and canvas. The canvas is somewhat similar to that which is used for coffee sacks, but cheaper, and the material, Mr. Marks says, is so cheap that plenty of it can be used, and it is now their practice to cover all the finished portions of their planers with this, and to stitch it on, the result being in every way entirely satisfactory, as it prevents slushing from being rubbed off and keeps out water. It is also the practice here to thoroughly slush the ends of all pieces of wood which come in contact with finished surfaces when crating or boxing, and this is believed, or rather, is found by experience, to entirely prevent the troublesome spots of rust which sometimes occur even where the machine itself has been thoroughly slushed, but where the end of a piece of timber comes in contact with it and removes this slush; there being in the timber sometimes sufficient moisture or acid to cause bothersome rusting.

Strange to say, one of the most interesting operations to be seen in this shop is for the doing of a thing which would be considered by most people to be of minor importance, and that is the cutting of the oil grooves upon the angular faces of the Vs of the planer platens. This work is done when the platen is in position for planing the Vs, and the workman simply takes a piece of chalk and marks out upon each surface the sinuous line he desires to follow in planing the groove. He then puts in a round-nose tool, sets the head to the angle of the V, and himself and another workman co-operate in then moving the vertical slide in such a way as to cut the groove at one stroke of the planer. One man manipulates the crank at the end of the cross rail which works the vertical slide; the other man has his hand upon the crank of the vertical slide itself; both have their eyes upon the chalk line, and they co-operate in moving the tool to its proper position; the idea being that when the tool once starts to cut this groove, it must be absolutely kept in its proper position during the entire stroke of the planer, or the platen will be spoiled. For this reason two men are put upon the job, so that if for any reason one of these men fails, or is unable to turn his crank at the proper time and rate, the other will be able to do so, and the job will not be spoiled.

In this shop they have done a great deal of experimenting in the way of high-speed planing, and their customers have also done a great deal of it, the benefit of which experience has eventually found its way into this shop. The general result is that with the modern high-speed steels, 40 feet per minute is found to be about the maximum cutting speed that can be employed to advantage in planing cast iron, even though steels are used in the tools, which when used in the lathe may be advantageously driven at a considerably higher speed. For some reason the tools do not seem to stand as well in a planer at, say, 60 feet per minute or more, as they will in the lathe, and it is found too that in many kinds of work the extra heat unavoidably generated by the high speed springs the work and makes necessary an extra finishing cut. There is also at high speeds a greater proportionate loss of time in shifting belts and reversing at the end of the stroke.

The character of the work to be done has some bearing upon the matter, of course, but in the Gray shop, where accurate and fine planing is required, 40 feet is found to be the maximum and 60 feet has been proven to be entirely too high. In fact the men in the works who make the most money planing by contract take finishing cuts at a speed of 12 feet per minute; the surfaces thus produced, and by means of extraordinary pains in grinding and setting tools, being admirably adapted to finishing by scraping, or if they are not to be scraped, they finish otherwise very readily and at comparatively low cost; the surfaces of cast iron as they come from the machine resembling closely surfaces produced by first-class grinding, and being in fact in many cases indistinguishable without careful inspection from ground surfaces.

Some time ago an English friend informed the writer that the business of American planer builders was practically dead in England. The English builders could, he said, supply machines, at least equal in quality, at considerably lower prices. However this may be, it is evident that it is quite possible to do business on the Continent, for Mr Marks incidentally said, in discussing the press of work in the shop, that while they were doing the best they could for their foreign customers, as they did also for the American ones, they were not quite able to fill all the orders offered. An order had been received a short time ago from a Continental house for 12 planers. They could supply only 8 of them within a reasonable time, and had to refuse the other 4. Business in fact is very rushing with this shop, and Mr. Marks expressed the wish that someone might invent a machine shop on the accordion principle, which might be pulled out when

orders were rushing and shut up when they fall off. At the

LODGE & SHIPLEY MACHINE TOOL COMPANY'S

shops they have also been doing considerable experimenting in relation to methods of driving lathe spindles, and one of the first things seen in going into the shop is an arrangement of six cone pulleys, all placed upon a single shaft in the central bay of the shop, and arranged so that anyone of these may be driven by a clutch. These cone pulleys differ from each other and comprise the whole range of pulleys used in connection with the lathes built by the company, so that any lathe may be placed upon the floor of this bay, and upon being lined up is immediately ready for a test. In connection with this arrangement there is on a table nearby, within a glass-covered case, a complete equipment of electrical instruments, by means of which the power delivered to any tool is constantly and accurately indicated. and a specialist has been employed in making tests, so that this firm now knows with accuracy just what may be expected of any lathe built in its works. As one result of these systematic tests, they have discontinued the building of their high-speed lathe and have devoted their attention to the perfecting of their regular form of lathe, and adapting it for higher speed and heavier driving; nearly all their lathes, of all sizes, being now gear-driven. As illustrating what may be done with such a lathe, I was shown a certain sleeve made of mild steel and used as a part of one of their own lathes. The piece of bar steel from which this is made weighs in the rough from 117 to 120 pounds. When finished it weighs about 37 pounds and it is found decidedly more advantageous to remove this amount of metal in the lathe, rather than have the piece forged to a rough weight of about 75 pounds, and to pay about one cent per pound more for the forging than for the bar steel.

As a test of what a lathe may do, I saw a piece of open hearth 20 to 25 point carbon steel turned in a 20-inch lathe, at a cutting speed of 67½ feet per minute as shown by a cut meter, taking a cut 5/16 inch deep, with a feed of 20 per inch.

The grinder for finishing the surfaces of lathe beds, between the guides and at the edges, which we illustrated some time ago, happened to be in operation, and it was interesting to compare its work and the cost of it with the method followed when the writer finished such surfaces with files and emery cloth.

They are using in this shop their variable-speed lathe countershaft for driving planers, the arrangement being such that the backing speed of the planer is constant, while the cutting speed may be varied considerably to suit the requirements of the work in hand. The business of manufacturing these countershafts has grown to such proportions as to require large separate shops for them alone.

As a part of the shop cost system followed here they were experimenting with an electric device, a part of which consists of a number of small clocks within the office, which clocks are made to drive dials, on which hours and fractions of hours are marked off. Upon connecting one of these clocks with any machine tool in the shop, which may be done by means of a suitable switch, there is recorded on the dial a complete graphic history of what the lathe countershaft was doing during the period under observation; that is, the dial shows the moment the lathe is started, and the moment it is stopped, how long it runs continuously, and how long it is stopped; the operator of the lathe having no means of knowing whether at a given time his own machine is making such a record or not. This, I understand, was not used as a spying system upon the men. The premium system is used in this work largely, and it is believed that the men are doing the best they can. It is used simply as an aid in becoming intelligent as to what the causes of delays may be, and as to the best method of overcoming the losses resulting from the fact that most machine tools actually run for a smaller percentage of the time than would be thought to be the case.

Legal Notes.

BY E. P. BUFFET.

DISCLOSURE OF TRADE SECRET.

Equity jurisprudence, whether still administered, as in New Jersey, by a court of chancery, or as under the modified systems of many States, by the same tribunals that follow common law, is peculiar in this respect among others, that the judges refuse to grant relief to parties who have themselves dealt unconscionably in those matters concerning which they seek redress. There is a well-known maxim running, "He that cometh into Equity must come with clean hands." An opinion involving this principle has lately been handed down by Vice-Chancellor Bergen, of New Jersey, in a most interesting case relating to disclosure of a secret process for detinning scrap. An outline of the circumstances will here be given, omitting, however, as is usual in these notes, the names of the parties, since it is sometimes difficult to determine and to indicate in brief compass how far the alleged facts have been proven, and especially since the Holland firm herein referred to was not a party to the suit and one of its members is quoted as having denied the charges.

A German firm was engaged in the industry of recovering tin from scrap by an electrolytic process which, it is claimed, depended for success on certain features which were not patented, but held as secrets, those of its employees who knew them being pledged not to divulge. A detinning factory was started in Holland by a firm which, it is charged, enticed away employees from the German one. According to a story published in a German periodical, the Dutch people even went so far as to keep men in the German plant after their engagement and surreptitiously to obtain through them important samples.

Subsequently, Mr. K., an American, after unsuccessful negotiation with the German firm, secured the establishment of detinning plants in the United States to put in practice information supplied by the Dutch firm. With him were associated Mr. A. and others. (We can for simplicity treat this American enterprise as a continuous company, although it was at one time divided and underwent some change of organization.)

By-and-by Mr. A. resigned, giving as a reason that he was an officer in a certain can manufacturing company which sold quantities of scrap to the company which had the detinning works, and that he could not consistently continue to occupy the position of buyer and seller. Shortly after he thus dissolved his relations, the can company began the erection of detinning plants of its own and employed men who had been in the service of the older concern, occupying positions which would naturally make them aware of its secrets. It is disputed whether this former employment had been under an express contract not to divulge the information, but the vice-chancellor is satisfied that such a confidential relation existed as to raise an implied agreement to that effect. A bill was filed in Chancery by the older American interests to enjoin the can company and Mr. A. and these employees personally from operating detinning plants or utilizing or operating factories in imitation of those of the complainant or using the secret processes.

The defendant can company seeks to justify its action in part on the ground that the process was not a secret one. The court indeed doubts that a secret process can be regarded as any longer existing. From a time dating before the can company began to build its plants, articles have been appearing in the press describing methods by which, the court thinks, the German one is substantially covered.

Admitting, however, that the process was no longer secret, there remained a question whether Mr. A. did not occupy such a position of confidence toward those who, in conjunction with him, had purchased the secret, and, relying on him, had become stockholders in the company to which he formerly belonged, that he was estopped from availing himself of the defense that the process was no longer secret. This view, the vice-chancellor thinks, a court of equity ought to take

had the process been acquired by the first American company properly. There is brought into consideration, however, a further circumstance. Mr. K., in obtaining the process from the Holland people, had sufficient notice of the unconscionable manner in which they had derived it from its rightful owner, the German firm, to charge him with knowledge of such facts as a proper inquiry would have disclosed, and this knowledge will be imputed to the interests for which he was acting in the business to which it related. The vice-chancellor therefore holds that the detinning company was not in a position to seek equitable redress, even if it had been wronged by the can company. "It is not to be conceived," says he, "that a court of equity will stain its hands by contact with such a disreputable proceeding." "It is not," he further remarks, "alone fraud or illegality which will prevent a suitor from entering a court of equity. Any really unconscientious conduct connected with the controversy to which he is a party will repel him from the forum whose very foundation is good conscience."

If any doubt still remained as to the propriety of dismissing the bill, it was settled by the fact that the can manufacturing company had subsequently secured a license from the original German firm to use the process.

62 Atl. Rep., 881.

It seems as if, to the average newspaper, hardly any "invention" is too chimerical, if it only involve the magic word electricity. This is, of course, explained by the vague notions popularly held regarding this medium, not surprising, indeed, when even the scientists cannot agree upon an explanation of its essential form. We learn now from a Belgian paper, that Professor Tamé, in Liguria, Italy, has at last discovered a method of bottling up electricity in vessels of water, so that twenty quarts of the magical water will run a twenty horse-power automobile for ten hours, at a cost of a penny per kilowatt-hour. This, of course, is to revolutionize the automobile industry; moreover, when the hydrated electricity is being purchased by the cask, barrel or bottle, "one must expect favorite brands to leap into fame, and perhaps certain vintages"; in place of coal, we will now buy water. Perhaps the origin of all this is that the professor has gotten up a battery which only requires filling with water to be ready for use. We are not told much about the receptacle, which is a part of the invention.

The selection of Pittsfield, Mass., as a starting point for numerous balloon ascensions under the auspices of the Aero Club, has led the Pittsfield Gas Company to procure machinery and pipe for installing a coal-gas balloon station near its gas holders. It is possible that some pure hydrogen may also be made.

Engineering Reminiscences.*

BY CHARLES T. PORTER.

The production of mechanically true planes by the method of scraping was first suggested by Mr. Whitworth, and was brought to perfection in his works. Having had and having improved the opportunity there to study this system, and having employed it largely in the manufacture of high-speed engines, it seems to me that an account of it should find a place in these reminiscences, especially as the importance of mechanical truth is coming to be more and more realized in this country. I will therefore describe the process of producing an original standard surface-plate.

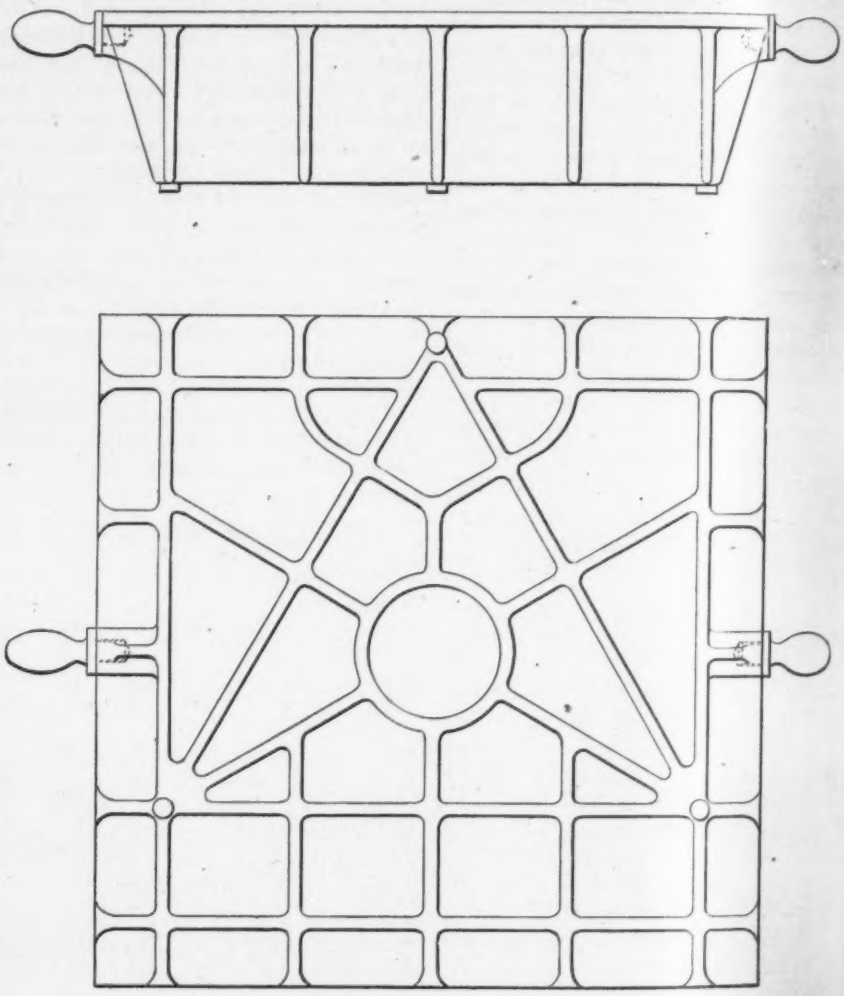

FIG. I. FACE PLATE FOR PRODUCING A TRUE PLANE.

The first point, of course, is the design. The square form, 30 inches square, has been found most suitable. I could not, however, use this form myself, a long surface-plate being required for the guide bars and steam-chest joint of my engine. It must be incapable of deflection. To insure this, it is ribbed on the under side, with ribs seven inches deep, and is supported at three points, equidistant from each other and from the center, so that its equal support cannot vary, whatever may be the surface on which it stands. It is provided on two opposite sides with handles, by which it can be lifted and rotated. The arrangement of the ribs and feet is shown in Fig. 1.

It must be cast of hard and close-grained iron, which will possess the most durable qualities, in a baked mold, without a cope, so that the gas shall escape most freely. As cast, the plate should be one inch thick. About three-eighths of an inch is planed off, removing all dirt, and leaving a perfectly sound surface, with a thickness of about five-eighths of an inch. Three of these plates are made. After these have been planed, their edges squared, and steel handles put in, they are delivered to the fitter.

I will first describe the tool used in scraping. Originally this was a hooked tool, and the scraping was done by a drawing motion. Two of these tools were employed, one for the roughing work, in which the hook projected downward about three-quarters of an inch, and the other for fine scraping. In the latter

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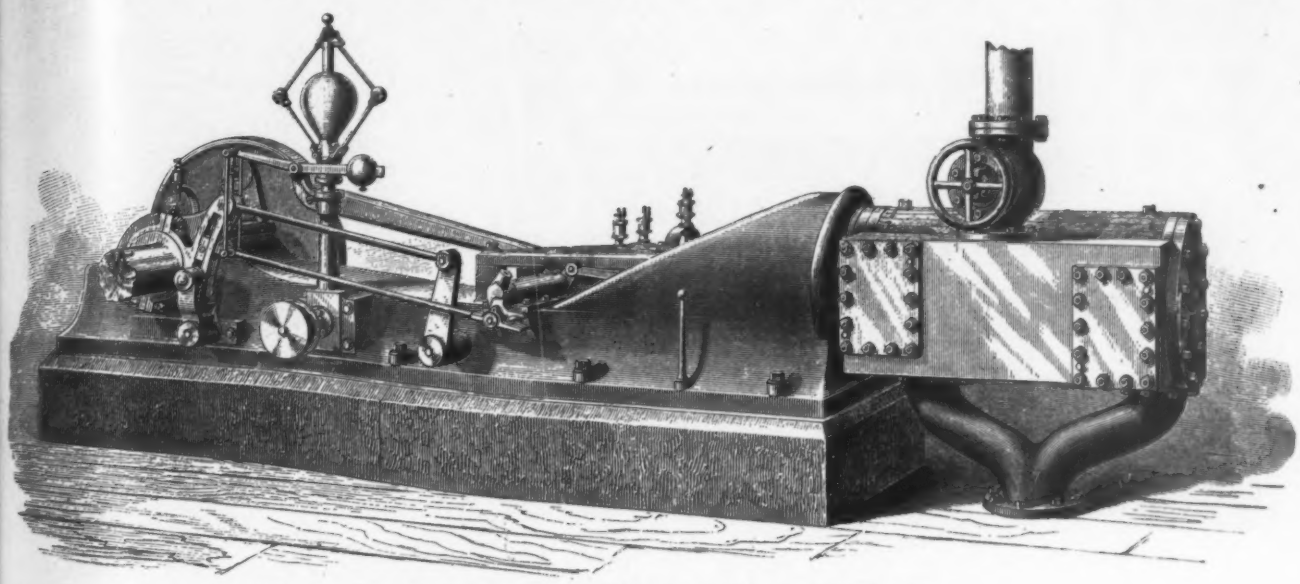
the hook projected downward only about one-quarter of an inch, and absolute freedom from vibration was aimed at. These tools were used for a number of years, but afterward a radical change was made. The modern method is, to employ a single straight tool, like a carpenter's chisel, about an inch and a quarter wide and an eighth of an inch thick, with a square end. This end is slightly curved, and its corners are rounded to avoid scratching the plate. The scraping is done by a pushing motion.

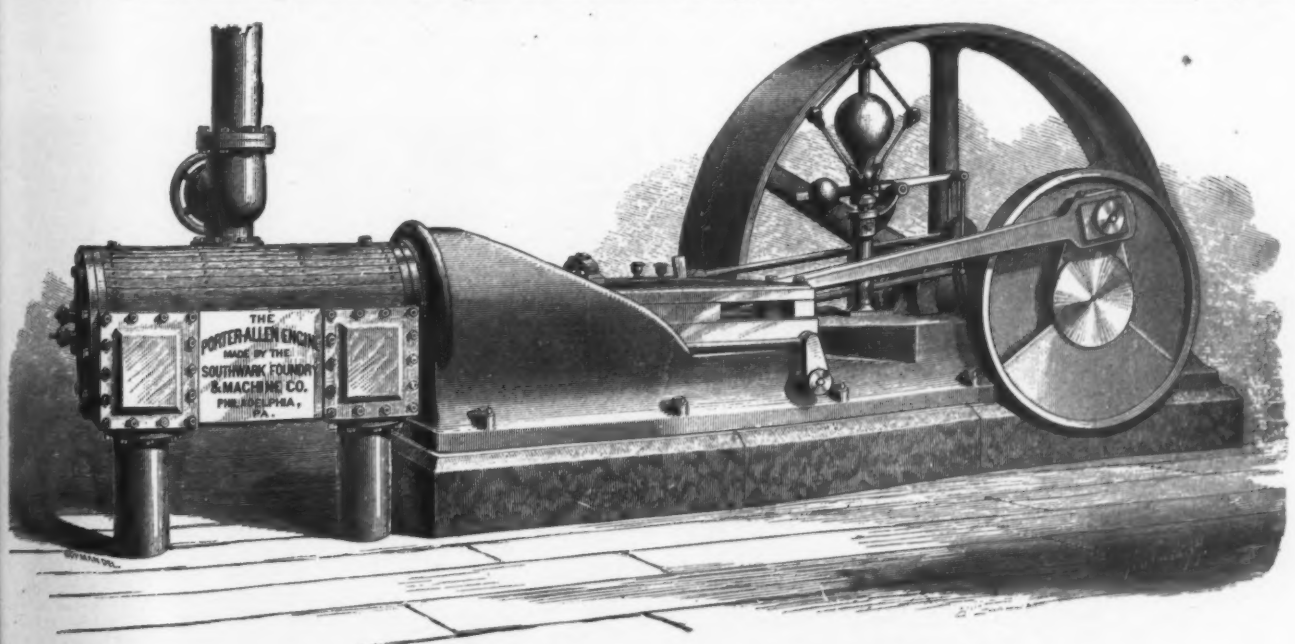
This tool has been found preferable on all accounts. Projections needing to be removed are in front of the tool, instead of being covered by it. The tool is perfectly rigid, and can be inclined to the surface at any desired angle. The cutting edge is a square angle, and being well supported keeps sharp for a considerably longer time than when it is an acute angle, and when ground or honed two edges are formed. Moreover, the pushing motion is preferred.

Two of the plates only are first brought together. For disclosing the high points, one of these is covered with a raddle made of finely sifted red lead and oil. This is made quite stiff, and all of it that can be removed by the palm of the hand is rubbed off, leaving only a very thin uniform film on the surface. Any dust having been carefully removed from both surfaces by a soft brush, one of these plates is inverted on the other, and at one corner each plate is marked in the edge with a prick-punch. The upper plate is then rubbed about on the lower one for, say, half a minute. When lifted off, the high portions of the surfaces are shown on one plate by the raddle put on, and on the other by that rubbed off. The workman then gives to these parts of the surfaces a general scraping, giving to his tool a long sweep, say from four to six inches. This is repeated two or three times, the stroke being shortened each time, and the upper plate being placed in a position at right angles with its last one, which can be determined by the prick-punch marks. This change of position is necessary to avoid a crosswind or spiral form. The scraping should now extend over the entire surfaces, and these should have a general uniform bearing on each other with the points of contact uniformly distributed, and equally distinct. The work should be continued in the same way until all these requirements are fulfilled.

Now appears the use of the third plate. The two surfaces thus formed are sure to be, one of them convex and the other concave, in some corresponding degree. The workman now numbers the plates, by numbers stamped in the edges, these



THE PROTOTYPE OF THE MODERN HIGH-SPEED ENGINE, FLY-WHEEL SIDE.



THE PROTOTYPE OF THE MODERN HIGH-SPEED ENGINE, CRANK SIDE.

being marked Nos. 1 and 2, and the third plate No. 3. Number 2 is now set aside, and number 3 is scraped to fit No. 1. It is thus made a duplicate of No. 2. Next, No. 1 is set aside, and Nos. 2 and 3 are brought together. Supposing these to be convex, they will bear together at the middle point, on which the upper plate will rock, and the degree of their convexity will thus be shown. The workman then in the same manner scrapes these plates equally to the best of his judgment, until their entire surfaces are brought together, with equal distribution of the points of contact. These two surfaces will now again be, one convex and the other concave, though in a much less degree. The next step is to apply No. 1, which is concave, to either No. 2 or No. 3, and scrape it to fit. It is then applied to the other, of which it has now been made a duplicate, and the same process is repeated, until the three plates can be interchanged in any way, and will have a uniform general bearing on each other, with equal distribution and distinctness of the points of contact. We have thus, in a general way, produced three demonstrated true planes, but the surfaces are yet far from the desired approximation to absolute truth.

Now follows the fine scraping, which is not attempted until general truth has thus been established. The object of this is to multiply the points of contact and perfect their equal distribution and prominence. For this operation no raddle is used, but the surfaces are rubbed together dry. When the plates are separated, the points of contact shine like stars. Here skill and care are pre-eminently required, the scraping takes off only a dust. If a little too strong, depressions may be made deeper than before, and requiring the reduction of the entire surface. The superiority of the modern tool is now especially shown. By lowering the angle of the tool, the workman presents the slightly curved edge to the surface in a position as nearly parallel with it as he desires. Interchanges similar to the former ones are now repeated, until the bright points are brought as close together as is desired, with uniform distribution and distinctness. The tedious operation is now finished, and these bright points remain as witnesses.

The three plates were necessary to the production of one. They have also a permanent use. They are indispensable to the preservation of the true plane, which it has cost so much patient labor to produce. The date of their completion is stamped on their edges. Then plates 1 and 2 are put away in the store-room, their surfaces carefully protected from rust or injury, which last is best avoided by inverting one on the other, and No. 3 is put into use. A prominent use is for the production of smaller plates or straight-edges adapted to special purposes. After a while, perhaps in a little while, this plate loses its truth by unequal wear. Indeed, speaking with absolute truth, it may be said that

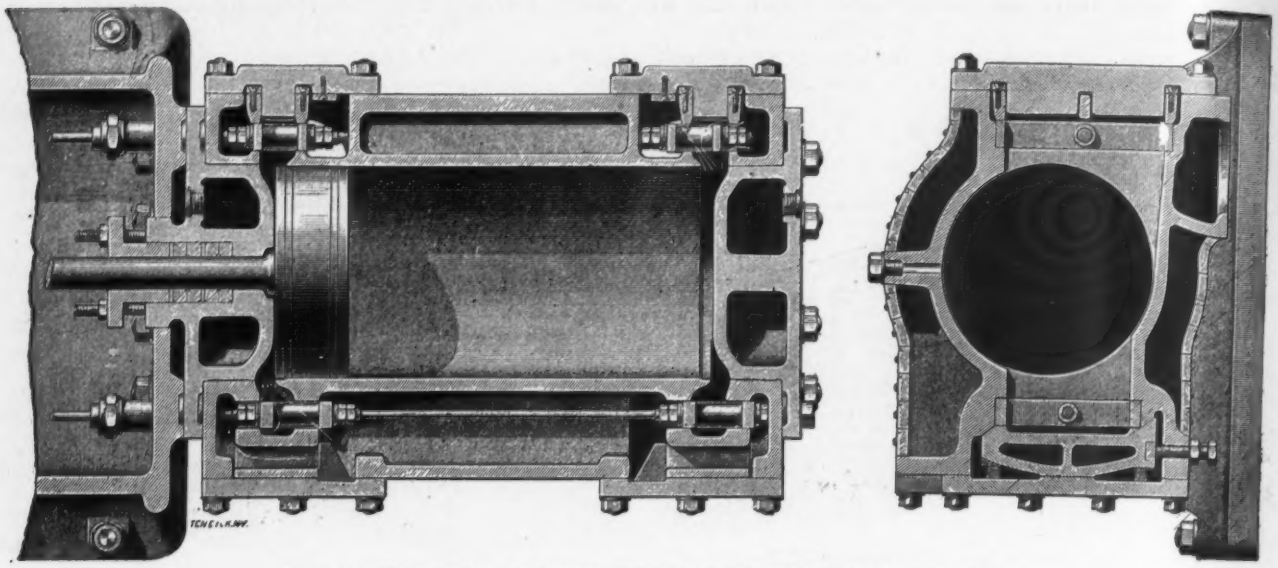


FIG. 4. LONGITUDINAL AND CROSS SECTION OF CYLINDER AND VALVES. FIG. 5.

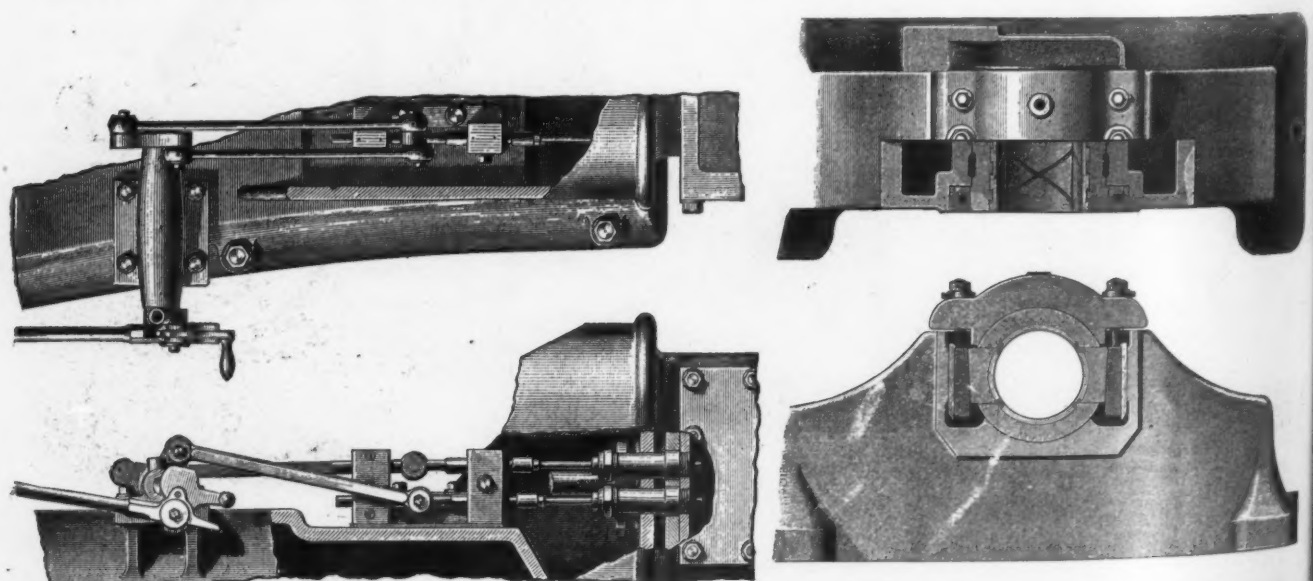


FIG. 6. ELEVATION AND PLAN OF VALVE CONNECTIONS.

FIG. 7. MAIN BEARING.

the first time this plate is used it is ruined. But by taking pains to use different parts of its surface as equally as possible, it may be kept in fair condition for some time. It can at any time be restored to its original condition by scraping it to No. 2, taking the same pains to turn it one-quarter way around at every rub. In the course of time No. 2 will itself become worn equally, when it can be restored by rubbing it on No. 1. Finally, the three plates can all be restored to their original condition by rubbing them together interchangeably as at first. Thus the true plane can be absolutely perpetuated.

at that very time, to the development of the high-speed system.

The design of the engine needed to be revised, and this revision involved study, to which time and leisure were essential.

As made up to that time, it was not reversible, and the valves could not be handled. It could not therefore be used in rolling mills, the field to which I felt already that it was especially adapted, but where sometimes a piece had to be backed out of the rolls. Moreover, every engine should be capable of being backed in starting, as otherwise whenever it had stopped with the piston at a point later than the latest point of cut-off, or say in the last

engine he wanted, a practice which resulted in a lot of patterns and drawings not adapted to other people's requirements, and not properly distributed. For an organized manufacturing business, this habit must be entirely broken up.

I had also an order from Elliott Brothers of London, to prepare a new and enlarged edition of the pamphlet descriptive of the Richards Indicator. I determined to make this a comprehensive book, embracing all information required by the steam engineer, so far as I knew it. This was published simultaneously in London and New York in the summer of 1874.

I felt warranted in giving to this edi-

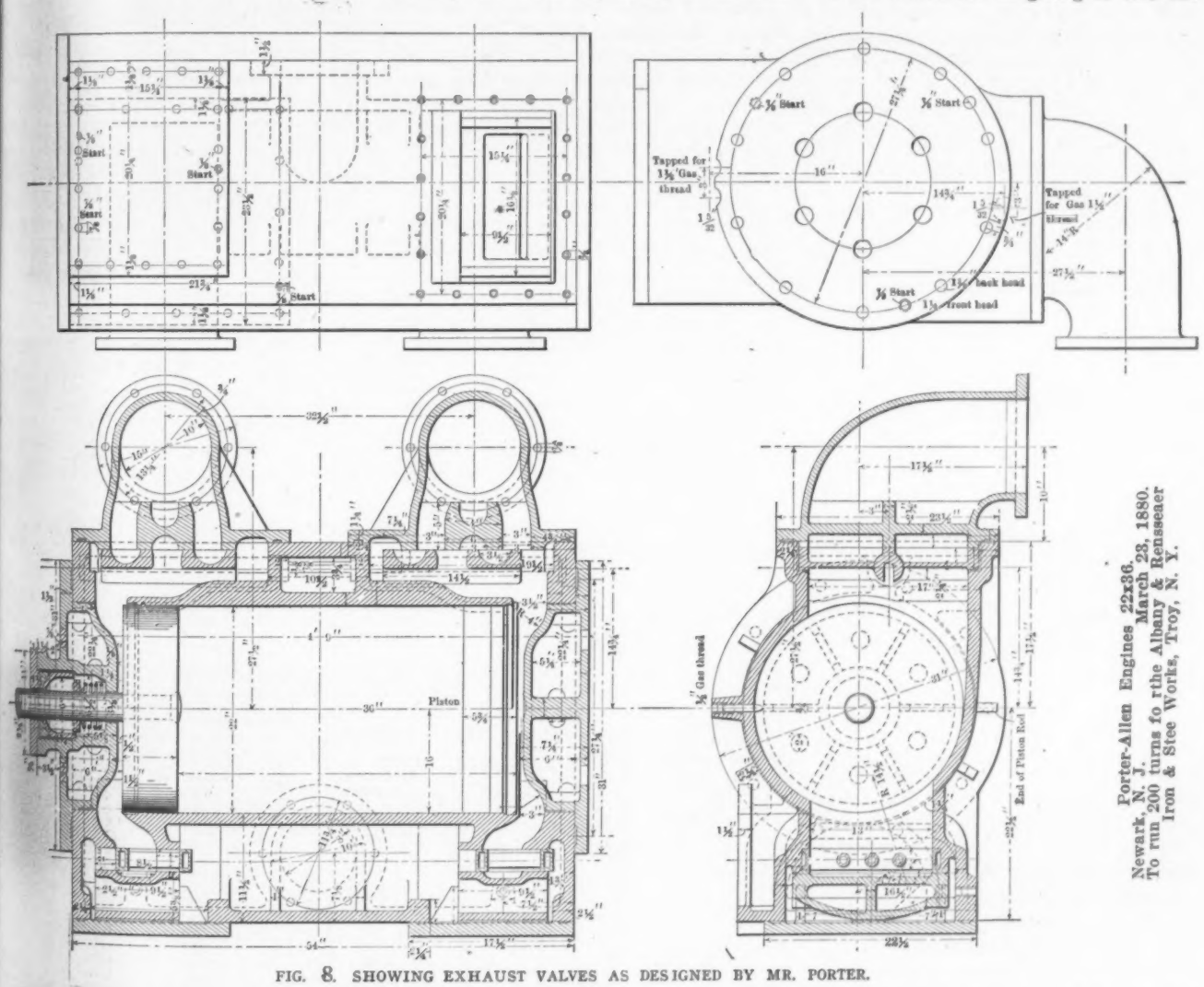


FIG. 8. SHOWING EXHAUST VALVES AS DESIGNED BY MR. PORTER.

The importance of this work can only be realized when we consider that the true plane affords the only means by which true cylindrical work also can be either produced or verified. It is thus seen to be fundamental to all mechanical truth.

REVISION OF THE ENGINE DESIGN.

With the completion of the engine for the Clinton Wire Cloth Company, the manufacture of the high-speed engine was closed for three years, from the spring of 1873 to the spring of 1876.

This long rest proved to be most valuable. Looking back upon it, I have always been impressed with its importance,

half of the stroke, which it would do half the time, it would need to be pulled around by hand to a position in which one of the admission ports would be open. This in a large engine, or one connected with extensive lines of shafting, would be a serious business, so much so that in some engines little starting cylinders are required.

Then the engine needed to be standardized, so as to cover all the field with the fewest number of sizes, symmetrically distributed. The existing practice with all makers of engines had been to let the purchaser dictate the size and speed of the

tion an amended title, as follows: "A treatise on the Richards Steam Engine Indicator, and the Development and Application of Force in the Steam Engine."

This also was a job requiring much time and undivided application. It is needless to say that without this entire rest from business neither of these tasks could have been undertaken.

I found in the Astor Library a remarkable old book containing a Table of Natural Trigonometric Functions, computed for every minute of arc, and extended to the fifteenth place of decimals. The column of versed sines enabled me to prepare

tables *exhibiting* the rates of acceleration and retardation of the motion of a piston controlled by a crank, neglecting the effect of the angular vibration of the connecting-rod. This effect was afterward shown separately. For my treatment of this subject, I must refer the reader to the book itself, as I find that any epitome of it here would be unsatisfactory.

A little incident in connection with this work, which made a deep impression on my mind, and has since afforded me some food for reflection, seems worth relating. The printing was done in London, and I did not see the proof, so I had to take es-

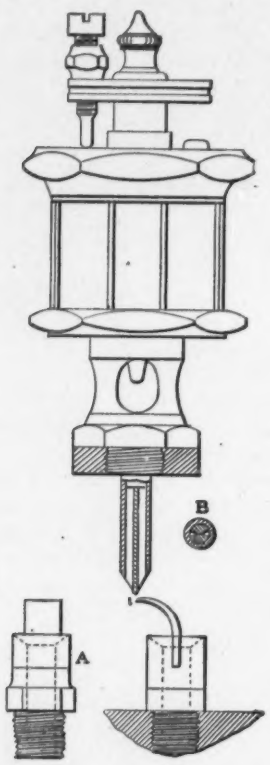


FIG. 9. ECCENTRIC AND CROSSHEAD PIN LUBRICATOR.

pecial pains with the copy, having no opportunity to revise it. I was living in Harlem, and at one time having no suitable envelope for mailing, and none being obtainable there, I took a Third avenue horse car for an eight-mile ride down to the New York post office, intending to get some envelopes at a stationery store on Beekman street, and mail the portion of the copy which I then had ready at the general post office. I had hardly taken my seat when Mr. Allen got into the car. He was living in Mott Haven, and I had not seen him for a long time. Besides ourselves the car was nearly if not quite empty. He came and sat down by me, and I opened my copy and read to him something in which I knew he would be interested. He said to me, "You would not express it exactly that way, would you?" On the instant it flashed on my mind that I had made a stupid blunder, and I replied, "I guess I wouldn't," and thanking him for calling my attention to it, I left the car, and returned home and corrected it. I have quite forgotten what the point was, and if I remembered it, I would not tell. But I have often asked myself who sent Mr. Allen there, saving me from publishing a mortifying blunder.

As soon as this book was off my hands I devoted myself to the revision and standardizing of the engine.

Mr. Allen had in his shop in Mott Haven, an unoccupied second story in which I had stored our patterns and drawings and drawing implements. Here I established my quarters, and spent my working hours until this second job was finished.

The two perspective views of opposite sides of the engine, Figs. 2 and 3, show these changes as they appear externally, and the six remaining views show some constructive details.

The first two show the exhaust valves transferred to the front side of the engine, and located so as to drain the cylinder, and the admission valves set at different elevations, to accommodate the differential connections; the abandonment of the separate steam chest, and this chest with the exhaust chambers cast with the cylinder, with openings over the valves; the levers by which the differential movements are given to the admission valves; and the single link rod, and the gab by which this rod is unhooked, with the method of moving the admission valves by hand.

In place of the levers on the steam rock shaft, I at that time drew cast-iron disks, which being polished and vibrating in place I thought very handsome. They gave me lots of trouble, till I learned enough to get rid of them, the story of which I will tell by and by. The front view shows the admission valve-stems balanced by being extended through at the back end, a feature which helped the governor action when high steam pressures were employed.

Figs. 4 and 5 show the valves in section and the adjustable pressure-plate and mode of its adjustment. The closeness of the piston to the head may be observed. I never allowed more than one-eighth inch clearance, and never had a piston touch the head. This was because the connecting-rod maintained a constant length, the wear of the boxes being taken up in the same direction.

The illustrations show the exhaust

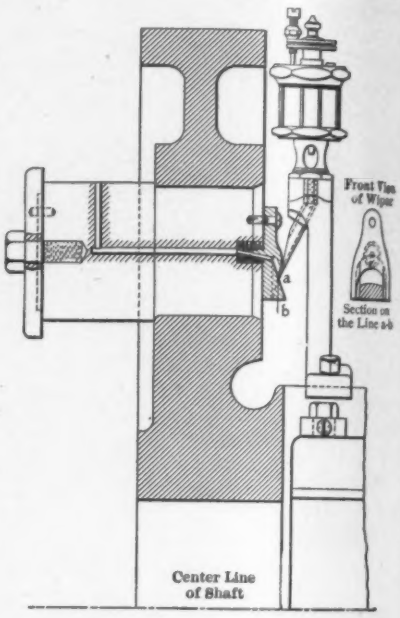


FIG. 10. CRANK-PIN LUBRICATOR.

valves after alteration made several years later in Philadelphia. As first designed by me, these are shown in Fig. 8. As will be seen, the exhaust valves lay with their backs toward the cylinder, worked under the pressure of the steam in the cylinder, made four openings for release and exhausted through the cover.

I consented to the change in Philadelphia because they involved too much waste room, but the change was not very satisfactory after all. I had become possessed with the idea that the engine running at high speed needed 50 per cent. more room for exhausting than for admission. This was not so. I have always regretted that I did not retain this design, and content myself with reducing the exhaust area.

Dimensions of Cylinders.		Revolutions of Crank per Minute.	Travel of Piston in Feet per Minute.	Indicated Powers.		Fly-wheels. Made when Practicable to Serve also as Belt-Drums.			Driving Belts.	
Bore.	Stroke.			Without Condensation.	With Condensation.	Diameter.		Weight of Rim.	Velocity.	Width.
Inches.	Inches.			Horse Powers.	Horse Powers.	Feet.	Inches.	Lbs.	Feet per minute.	Inches.
6	12	350	700	25		3		350	3300	9 single.
7	12	350	700	35		3	6	400	3850	10 "
8	16	280	746	45	60	4		650	3520	12 double.
9	16	280	746	60	75	4	6	700	3960	12 "
10	20	230	766	75	100	5		1300	3610	14 "
11.5	20	230	766	100	125	5	6	1450	3970	14 "
13	24	200	800	130	160	6	6	2100	4084	18 "
14.5	24	200	800	160	200	7		2350	4400	20 "
16	30	165	825	200	260	8		4000	4180	26 "
18	30	165	825	250	330	9		4000	4670	30 "
20	36	140	840	320	400	10		6000	4400	38 "
22	36	140	840	400	500	11		6000	4840	42 "
24	42	125	875	480	620	12				
26	42	125	875	560	730	13				
28	48	112.5	900	670	870	16				
32	48	112.5	900	870	1140					
36	48	112.5	900	1100	1430					
40	48	112.5	900	1360	1750					
44	48	112.5	900	1600	2100					

The powers are those given by an initial pressure of 85 lbs. on the square inch, cut off at about one quarter of the stroke. For the best economy steam should not be cut off earlier than this, unless a higher pressure is carried. At the latest point of cut off, the powers developed are double those given in the above Table. The engines can be worked under locomotive pressures, with corresponding increase of power.

The lightness of the piston in this view will be observed. This was a special design for adapting the engine to be run at 200 revolutions, giving 1200 feet piston travel, per minute. The stuffing box was a freak which was abandoned.

Fig. 6 shows the valve-stem guides, rocking levers, coupling rods and gab, which latter when thrown over unhooks the link-rod, as is done on steamboat engines.

Fig. 7 shows the construction of the main bearing with adjustments on opposite sides, by which the shaft is kept in exact line, and shows also the solid support of the shaft quite out to the hub of the crank. This view contains one error. The cap is not made a binder. I relied on the strength of the thick continuous web of the bed under the boxes in addition to the depth of the bed. But we once had a bed break right here under enormous strain and since then the caps have been made binders. It will be observed that the wedges are drawn upward to tighten the boxes. It is not necessary to explain why.

Fig. 9 shows the automatic lubricator of the eccentric and the crosshead pin. The stud *A*, on the eccentric strap and on the strap of the connecting-rod, carries a curved blade *a*, which at the beginning of each forward stroke rises to take the drop of oil from the stem of the sight-feed lubricator. This is set on an arm fixed on the cap of the main-bearing and on a bridge between the upper guide bars (see Fig. 2). The drop is made sure to come to this central point, by a wire *B* filling the brass tube, grooved on opposite sides, and terminating in a point.

The automatic lubrication of the crank-pin presented a still more serious problem. It was solved by the construction shown in Fig. 10, which will be understood without further description. It will be seen that here the oil tube is inclined, and the drop follows it to a point on its lower side. Both these lubricators proved absolutely reliable. The last one is equally applicable on double-crank engines.

After considerable study I finally adopted the accompanying table of standard sizes and speeds, covering the ground, from 25 horse-power up, with nineteen sizes.

As the bed could not be reversed, I needed both a right-hand and a left-hand bed for each size. I avoided half of this expense in patterns by planning two diameters of cylinders with the same stroke, and making one bed answer for both.

Until I found something else to do I employed myself in preparing complete drawings for three or four smaller sizes of engines; a work which afterward proved exceedingly useful.

A Japanese paper states that there is an increasing demand for leather belting in that country, which cannot be met there.

An Analysis of the Cutting-Off Machine.

BY FREDERIC R. HONEY.

An examination of the controlling pieces in the mechanism of the Pratt & Whitney cutting-off machine reveals some interesting combinations. In order to ascertain the principles which have guided the manufacturers in proportioning them, an exhibit is here given of these elements in an ideal machine, i. e., one which would be theoretically perfect, but, as we shall presently see, can be imitated only approximately in practice.

A machine theoretically perfect would save exactly 50 per cent. of the time which would be occupied by feeding the tool uniformly from the circumference to the center. This will be apparent from a comparison of Figs. 1 and 2, each of which represents the section area of a round bar, i.e., πr^2. Let r, the base of the right-angled triangle, Fig. 1, represent the radius of the bar. The circumference is equal to the perpendicular $2\pi r$. This may be taken to represent the cutting speed in a given time when the tool is commencing its work. As it advances uniformly from the circumference to the center, the cutting speed is represented by ordinates limited by the hypotenuse. For example when the tool is midway between the circumference and the center the cutting speed is represented by πr. The length of this ordinate also represents the amount of metal removed, which is one-half that at the circumference. The cutting speed diminishes uniformly from $2\pi r$ at the circumference to nothing at the center.

If the cutting speed be made uniform, the long sides of the rectangle, Fig. 2, correctly represent it. Since a uniform speed is maintained a line is drawn parallel to the base $\frac{r}{2}$. If it were possible to maintain the cutting speed uniformly to the center, the time occupied would be in the proportion of $\frac{r}{2}$ to r; i.e., one-half.

In order that the cutting speed may be uniform the bar should revolve at an increasing angular velocity, and the tool should advance to its work at a corresponding rate. For example, when the tool has reached a point midway between the circumference and the center, in order that the same amount of metal may be presented to it as at the beginning, the angular velocity should be doubled, and the tool should advance at twice the rate; when the tool is three-quarters the way through, the angular velocity of the bar and the feeding of the tool should be quadrupled, and so on. An ideal pair of cones Fig 3, may be constructed, which will theoretically fulfil these conditions.

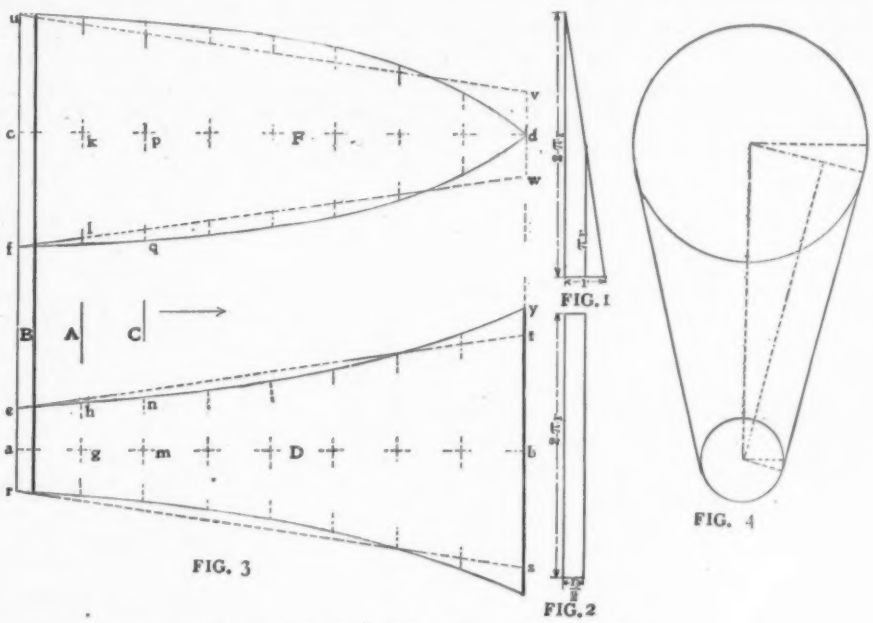


FIG. 3

FIG. 4

SPEED CONES FOR THE CUTTING OFF MACHINE.

Let *D* be the driver, and *F* the follower. The driver takes its motion from the countershaft, and has a uniform angular velocity The follower receives its motion from the driver by means of the belt *B*, and should have an angular velocity which should vary according to the law stated above. The follower, by suitable gearing and mechanism, controls—1st. The angular velocity of the bar, which is to be cut off. 2d. The feeding of the cutting tool. 3d. The motion of the belt shipper which guides the belt in the direction of the arrow from one end of the cones to the other, while the tool is advancing from the circumference to the center. Here we may remark that the position of the belt indicates the corresponding position of the tool, i. e., when the belt is midway between the ends of the cones, the tool is halfway between the circumference and the center, and so forth. The belt shipper therefore has also an increasing speed

which is proportioned to the feeding of the tool.

The contours of the cones are determined as follows: Let *ab* and *cd* be the axes; and let *ae* and *cf* be the radii of the driver and follower cones when the belt is at *B*. These radii are designed to impart to the bar the angular velocity which will correspond to the required cutting speed. Divide the axes into any number of equal parts—we will say eight. When the belt has reached the position *A* the tool will have advanced one-eighth of the radius. In order that the cutting speed may be maintained at a uniform rate, the angular velocity of the bar should now be $\frac{8}{7}$ of that which was imparted to it at the beginning; i. e., the radii *gh* and *kl* should be in the proportion of the numerator to the denominator of the fraction $\frac{8 \times ae}{7 \times ef}$. Similarly when the belt has reached the position *C*, or one-quarter of the distance, the proportion of *mn to pq* should be determined by the numerator and denominator of the fraction $\frac{4 \times ae}{3 \times ef}$. These radii, or the ordinates of the curves will be in proportion to the numerators and denominators of the fractions obtained by the following products—

$$\frac{ae}{cf}, \frac{8 \times ae}{7 \times cf}, \frac{4 \times ae}{3 \times cf}, \frac{8 \times ae}{5 \times cf}, \frac{2 \times ae}{1 \times cf}$$
$$\frac{8 \times ae}{3 \times cf}, \frac{4 \times ae}{1 \times cf}, \frac{8 \times ae}{1 \times cf}, \frac{x}{o}.$$

In each case the numerator gives the proportionate length of the ordinate of the driver, and the denominator that of the follower, but for the *actual* measurement this must receive a slight correction. For in order that the belt, whose length is invariable, may embrace the cones at every point, it becomes necessary to modify their outline in order to fulfil this condition. The first step to ascertain the length of the belt *B*, which will embrace the small end of the driver and the large end of the follower. This is found by the formula for an open belt Fig. 4

$$L = 2\sqrt{d^2 - \overline{R-r}^2} + (R+r)\pi + 2(R-r)\text{ arc sin. }\frac{R-r}{d}$$

in which d = distnce between the axes; R and r the radii of the cones. The next step is to ascertain the lengths of the ordinates, or the radii of the circles embraced by the belt whose length is now known. In each position of the belt the proportionate relations above described must be maintained, and then submitted to the formula for the length of the belt. The process is tedious, since the measurements must be obtained by trial and error. The outlines of the cones, drawn carefully to scale, are exhibited in Fig. 3; and if these forms were practicable, 50 per cent. of the time would be saved. But in the observance of the law, which requires a constantly increasing angular velocity of the bar, and a corresponding increase of the feed of the tool, as the axis is approached the velocity in each case becomes impracticable. For example when the tool reaches a point within a distance of ⅛ of the radius from the center, the angular velocity of the bar and the feed of the tool must be eight times that at the beginning; at $\frac{1}{16}$ from the center, the velocity must be sixteen times; and so on for both bar and tool at a very rapidly increasing velocity until the axis is reached when it would become infinite. This is indicated by the radius *by* of the driver, and that of the follower which reduces to nothing. Even if it were possible to adapt a belt to embrace the cones constructed in this way, the velocity near the end of the work would exceed practical limits.

The simplest and most practical compromise is made by introducing two frustra of cones exactly alike, and placed in a reverse position. These straight outlines follow the general direction of the theoretical curves, intersecting them within a short distance of the end, when the tool has very nearly reached the axis, and leaving not more than a very small fraction of the metal to be removed. A sacrifice of speed is made where the practical limit is passed, and when the work left to be done is only a very small percentage of the whole. The area of a circle of less than ¼ inch diameter is less than $\frac{1}{16}$ that of one 1 inch diameter. That is, before this sacrifice in speed is made, 15/16 of the metal has been removed. It should be noted, however, that, in order to maintain an average speed approximating an assigned cutting speed, it is necessary to make the initial speed less than the average. It will evidently reach its maximum about midway between the first position and that in which the straight lines intersect the theoretical curves, i. e., when the diameter of the driver is greater, and that of the follower less than those given by the theoretical curves. There is a provision for this adjustment.

In order that the belt may embrace these cones without slack at every point, the outlines should be slightly convex curves, which would intersect the ideal curves at the same distance from the large end of the driver and the small end of the follower. Practically this form is proved to be unnecessary, since the slack is a very small percentage of the total length of the belt. For this reason straight outlines, i.e., true frustra of cones, have been adopted.

In first quality commercial tin ingots there are usually 0.1 to 0.2 per cent. of impurities; in second quality there may be as much as 1 to 2 per cent., usually iron, lead and copper, but there may be small quantities of the following elements: antimony, tungsten, arsenic, molybdenum, bismuth, zinc, manganese, nickel, chromium and sulphur.

Letters to the Editor.

The Liability of the Machinist.

The letter of J. L. Gard on "The Liability of the Patternmaker," at page 583, Vol. 28, Part 2, and the further consideration of the subject by Mr. Osborne in his letter, "How Much Responsibility Goes with the Work a Man Does" at page 418 of the present volume, recalls an instance in my own experience that is perhaps a little different from any of those recited.

The engraved copper pattern roll of a cloth-printing machine is mounted on a tapered mandrel about seven feet long and in this case its largest diameter was only about 3¼ inches. The taper was about 1/16 of an inch per foot. These mandrels were generally ordered from a concern that made a specialty of this class of work, but whose shops were located about 150 miles from the plant where they were used.

On this occasion, owing to a particular grade of goods being run, heavy pressure was being exerted on the pattern roll and this excessive pressure caused the mandrel to break off in the fillet corner where the mandrel was turned down to a smaller size for the journal bearing. Three of these mandrels were kept in stock for such occasions and when the first one broke, a sketch was mailed to the manufacturer with orders to make a new one. Unfortunately the other two were broken during the next few days and rather than have the machine stand idle until a new mandrel arrived, it was decided to have one made in a near-by machine shop. A broken mandrel and one of the copper pattern rolls were carried to this shop and the manager personally supervised the ordering.

On mandrels of this kind the fit must be a very nice one, because a slight error in the mandrel would be very apt to show up on the form of the copper roll, thus making the impression vary in density. Moreover, as a shallow keyseat is cut the full length of the taper fit and about ½ inch wide, there is a tendency to spring because of removing this metal. To avoid these difficulties, the mandrels when turned are left slightly large and after keyseating, are carefully drawfiled to fit one of the standard copper rolls. The manager knew this, but not being a mechanic, did not realize the size of fractional parts of an inch and did not know very much about drawfiling; therefore when he placed his order with the order clerk of the shop, he told him to have the mandrel turned 1/16 of an inch larger than the old one and after keyseating it, to drawfile it to fit the accompanying copper roll.

The order clerk accurately copied these instructions into his order book and later reproduced them in the shop order. When the shop foreman came across these instructions, he very naturally thought some

one was "daffy." After looking the job over, he had a latheman turn up a mandrel to the size of the old one, cutting the keyseat after finishing to size.

When the job came back to the plant the manager inspected it, but could find no drawfile nor any other file marks, as the man had used soda water on the finishing cut and considered the job good enough. It was tried in the machine and found that owing to slight inequalities in the surface, the work turned out was not perfect, but because of the urgent need of getting the goods out within the contract time it was made to do.

The manager, of course, took up the matter with the shop to find out why his instructions had not been followed and was told that the shop foreman considered the instructions unreasonable. They further cited the fact that his using the mandrel proved its efficiency. He on his side claimed that as they did not follow his instructions, they did not complete the contract. However the mandrel was paid for and the matter dropped.

Suppose the immediate need for that mandrel had not been so great and on the ground of the slight imperfections in the work coming from the machine, the manager had rejected it, would the shop have been in duty bound to replace it with another one, made according to the manager's instructions? Was it the duty of the foreman or of the shop to follow those instructions explicitly, to modify them sufficiently to secure equally good results with less labor cost or to call up the manager on the 'phone, explain their position and ask for further instructions?

L. L. ARNOLD.

Photographing Blue-prints.

Referring to the question of photographing blue-prints, to which attention has been given by some of your correspondents of late, I may call attention to the method which has been used by myself for a number of years, and which I have communicated to several photo-engravers who are now using it in their regular work.

The print is first placed in a tray containing a dilute solution of ammonia, say about 5 per cent. strong aqua ammonia in water, upon which the blue color will slowly fade, disappearing altogether in the paler portions, and remaining a faint pink in the deeper parts.

After the blue color is entirely gone the print should be washed well in clean water, and then placed in a tray containing a weak solution of tannic acid, whereupon the whole detail of the print will return in a non-actinic red, the depth depending upon the time of immersion, and which can be watched and arrested as desired. The print should then be washed and dried, and can be photographed with perfect success. A blue-print of a line drawing thus treated will give a negative having black lines upon clear glass, and this can then be backed with white paper and used for copy for a line engraving by the zinc or copper photo-engraving process.

H. H. SUPLEE.

Interchangeable Boring-Bar Cutters.

At page 419 A. V. brings up the matter of interchangeable boring-bar cutters and I agree with him as to the merits of what he shows.

Circumstances have forced me to consider this subject seriously. There is nothing new about either the lipped or pin-centered cutter but owing to the greater ease with which the bar and cutter could be made when using the lipped system it is the commonest where interchangeability is necessary.

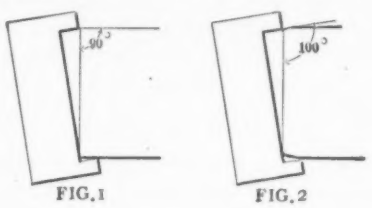


FIG. 1

FIG. 2

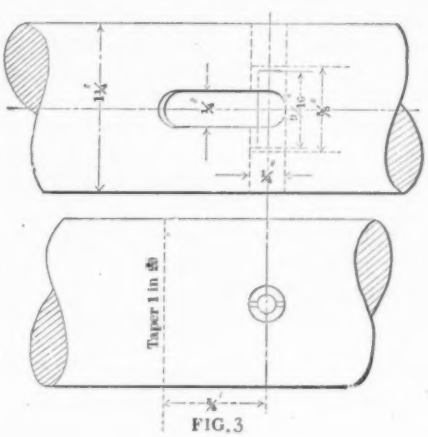


FIG. 3

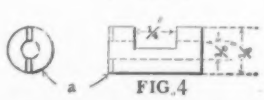


FIG. 4

INTERCHANGEABLE BORING-BAR CUTTERS.

The usual method of spoiling such a bar is to put the cutter as indicated in Fig. 1 and drive the key. Changing the angle of the corner as shown in Fig. 2 stops that and makes a better job. Fitting mushet cutters that way is a different thing. Where a bar has to take cutters made of material that does not anneal, the pin is probably the best means of centering them but it is not free from troubles, those mentioned by A. V. being among them but not the worst. The groove must be ground to fit the pin, easy to say but another thing to do. I have not seen it done satisfactorily. The bearing between cutter and pin is on a couple of spots or ridges. One cutter strikes the pin one way, the others in other ways, the result being the destruction of the pin. The problem is therefore, to make bar so that pin may be renewed at small cost and provide for its being properly located.

As the bars with which I had to deal were often large, reaching to 5½ inches diameter by 20 feet long, the ordinary milling machine could not well handle some of them. Drawings and patterns for a special machine to do the work have been made, therefore what I have to offer must be regarded somewhat as suggestive.

To begin with I propose to put the groove in the cutter at the time it is cut off and while it is yet hot, finishing it when cold by lapping on a pin of the same size as that in bar, two may be lapped at the same time.

The proportions of cutter, slot and pin can be simple, see Figs. 3 and 4. Of course these proportions may be varied to suit circumstances. The merit I claim for this plan is the ease with which the pin—the only difficult part—can be duplicated, little liability to breakage, lowest cost, least time required for production and entire absence of all cut-and-try operations.

The proposed machine is a modified slot driller, drilling the pin first, from both sides simultaneously, then reaming with a pilot reamer driven by one spindle and guided by a bush in the other. A pin in the hole brought up to a fork in one spindle squares it and locates it endwise. The bar is held in Vs as is usual in centering on similar machines and once adjusted to center the job is simple. The machine was designed for 6 inches diameter and under. The slot *A* in the end of the bush is to guide it when driving it in.

JAMES BELL.

The Value of Technical Education.

From time to time there appears in technical periodicals articles dealing more or less intelligently with the subject of the value of technical education. Some persons seem to greatly overestimate the direct benefits derived from such education, while some seem not even willing to give the technical graduate a fair chance. The object of the following remarks is not so much to add to the already voluminous discussion as to bring out a few points of view which are very seldom considered, but which cannot be entirely lost sight of.

Writers on the subject have been fond of quoting figures giving the average pay of technically educated men at certain ages, and then comparing these figures with the average pay of men of general shop experience. Thus I have seen it stated that the technically educated man at age of 30 receives on an average $40 a week. Whether this average is not rather high, is not within the limits of this discussion, although, if it is correct, it confers upon technical college education a very great value as compared with the average pay received by persons not so educated. This high average, however, most likely is arrived at by taking a number of college graduates at random, and the average will be greatly increased by the sal-

aries of those graduates who, before entering the college, were designated to some important positions, or as members of firms, positions which they hold not only on account of their superior ability or education. This is an important point, which must be considered whenever discussing the value of technical education. A great number of our college graduates who fill responsible technical and business positions cannot look to their education as the only factor determining the success they have experienced. Their personal relation to the firm where they are employed is often a factor of as great importance. Let us not forget that the relatives of the members of the firm are always the men most benefited by technical education.

I do not mean to say that the education itself has not its value. In fact, it is not too much education we suffer from, but too little. However, it is only fair that it should be clear to any young man about to enter a college, that it is not at all *sure* that *he* will find the education he acquires to be of such great pecuniary value as he often may hear some men tell him. I have heard many a young man, unfamiliar with the ways of the world, express his disappointment that after years of hard work in acquiring technical training he has not found conditions such as painted to him in earlier years. He has seen that men inferior both in regard to intellect and education have occupied superior positions on account of factors that are often more potent than knowledge.

Technical education has a value that cannot be estimated at so and so much a week. It gives greater opportunities, it develops self-reliance, it brings into existence many abilities that might have been dormant, but for the educational stimulus. It may bring much satisfaction of a kind that does not come through money at all. It has a value in many respects not comparable with money-value, but let us not lose sight of the fact that when an average commercial value is attempted, so many subtle factors come into consideration that a fair estimate is practically impossible.

THE OBSERVER.

Decimal Equivalent of Ounces.

Quite frequently I have occasion to use the decimal equivalent table for transposing decimal parts of a pound to ounces. I have never heard of its being used for this purpose, but consider it very convenient. For instance should I wish to obtain the weight in pounds and ounces of a cast-iron ball 4 inches diameter, I would use the customary formula to calculate it, which gives 8.712 pounds. By referring to the decimal equivalent table I find .712 is about 23/32 and as each 1/16 inch is considered an ounce, .712 pound will be 11½ ounces, which makes the weight of ball 8 pounds, 11½ ounces.

C. E. J.

Badly Designed Tools.

I note that Mr. DeLeeuw in the course of his article on boring-mill design at page 472, takes occasion to mention the fact that the average user of a machine thinks that he could give the designer points on designing. I suppose that everyone is subject to a greater or less extent, to enlargement of the head, but still everyone who has worked in a machine shop can recall plenty of cases where, if the designer had to work in the shop and use his own machines, he would want to modify the designs as soon as possible.

In our shop there are two shapers. If we wish to change the length of stroke of one, all the nececsary hand wheels are an integral part of the machine, and there is a graduated scale which at all times shows exactly the length of stroke to which the machine is set. For the other machine we hunt up a loose crank handle, apply it to the squared end of a projecting spindle, turn it, and then pull the machine around by hand to find whether we are adjusting in the right direction or not. After getting the length of stroke adjusted by the cut-and-try method, if we wish to set the ram forward or back we take the same handle and travel around to the back of the machine to get at the adjusting screw. In the first-mentioned machine this adjustment can be made from the front of the machine, and there are no loose parts to get mislaid.

If we wish to swivel the vise around at right angles, one machine has a spring pin to locate the vise at 90 degrees, while the other has a common key that usually sticks in the keyway, and we have to hunt for some kind of a bar to pry it out, and then tap it into place again after swiveling the vise. If we wish to remove the vise and clamp a piece of work directly on the table, we get the work in place and find no bolts about the machine that are suitable for this particular job, and the T slots are too shallow to take a standard head bolt.

One of the planers has slots with the sides planed to an angle of about 30 degrees so that every bolt used about it must have a special head.

If we wish to reverse the carriage travel of one of the lathes, we have to take a wrench and loosen a screw, swing the arm to engage the reverse gear and then tighten up with the wrench. Only one feed can be had on this lathe without changing gears. On another lathe we must go around to the rear side to throw in the lead-screw nut.

I know that there are modern tools in which these defects do not exist, but they are not the kinds of tools we have to work with.

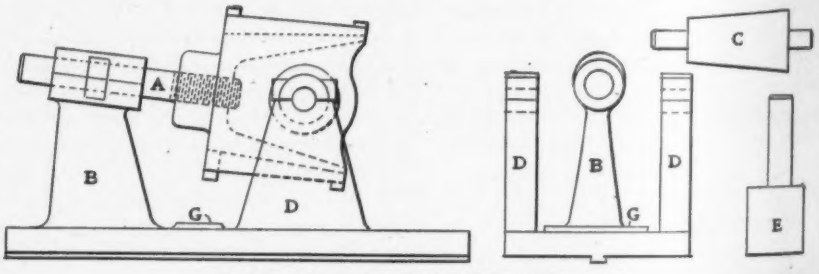
It seems sometimes as if the men who purchase machinery do not take anything into consideration but the price, and forget that a tool that is not handy for the operator is a constant source of loss as long as it remains in the shop.

I also notice that sometimes these same shop owners read of rapid rates of working with modern tools specially designed to use with high-speed steels, and they forthwith purchase a few pounds of this steel, and expect their men to equal the records made in modern shops, forgetting entirely that the results obtained are quite as much due to the machine tools as to the steel used. When they find that no great increase of output occurs they complain of the poor mechanics they have when much of the fault is due to the out-of-date machine tools they are using.

W. ALTON.

Making Interchangeable Crossheads.

The illustration shows a fixture used for milling the taper on crossheads, to fit the gibs. These have to be exact duplicates as we are continually sending off gibs on repair orders, which would occasion no end of trouble if they were not exact duplicates. This was impossible under the old system, but with this new fixture it is almost impossible to make any mistake. A special arbor *A* is screwed into the nose of the crosshead with the end resting in *B*, the end bearing of fixture. A special arbor *C* is driven into the wrist-pin holes and rests upon the side bearings *D*. This insures perfect alinement of the crosshead and piston rod. The center line of the front and side bearings is on a taper 1½ inches to the foot, which allows for the adjustment of the gibs. The cutters are set central by means of a size plug *E*. The shank fits the bearing *B* of the fixture, while the plug end is the exact width of the cut required, the cutters are lined up to the plug. The depth of cut is determined by a hight block which is set upon the boss *G* in the center of the fixture. The cutters are brought to just touch the top of



MAKING INTERCHANGEABLE CROSSHEADS.

the block. The crosshead is milled upon one side and then turned over, which is quickly done as the bolts which clamp down the caps are swivel bolts and drop down when loosened, to allow the caps to be removed. These swivel bolts do not show in the sketch, owing to my limited skill as a draftsman. At page 212 there appeared a very interesting article on crosshead manufacture, by J. C. Dufresne. His fixture for holding the crosshead was very similar to mine, excepting that instead of turning the crosshead over sideways, he turned it over endways, making a double-ended fixture of it. As he has to remove the bar every time I think my way a trifle the quickest, although his way is certainly all right. TEXAS.

Reply to Apprentice.

Apprentice's state of mind, as set forth at page 455, is an inevitable one. He clearly did not get a square deal, or else the foreman sized him up as not being worth advancement, in which case it was hardly a fair deal either, as he ought to have been fired. It is just such conditions that the advocates of trade schools wish to better. The reason why such a state of things can exist is not hard to find. A shop proprietor usually neither knows nor cares whether his apprentices pay him a profit or not. He does know that his foreman will give him a steady tale of woe if there are many of them. Foremen do not like apprentices; they are kept busy enough if they keep work going along smoothly with the best possible workmen, without trying to teach boys at the same time. Many foremen do not have the qualifications of a teacher, and they all know that if they turn the boys over to the workmen for instruction that the latter will make it an excuse for spending a lot of time unproductively.

A foreman cannot be blamed for putting on a doleful face at such a prospect, and those who have had experience hiring foremen will not blame the proprietor for cutting down the number of apprentices to suit the foreman's taste. A good foreman is not to be picked up every day, and when a good one has been secured, that is not all; he must be kept good. To keep him good he must be kept good-natured, and no one thing that is easy to do will help more to keep him good natured than to cut down the number of apprentices. If this is not done, the state to which Apprentice refers is likely to develop. The easy way out of both predicaments, on paper at least, is to concentrate the apprentice business in a single shop. The proposition may be sugar-coated and called a school, if that is preferred.

Another thing that Apprentice hints at is that the term of service is longer than necessary. That has been threshed out so many times in these columns that I am not likely to add anything to it; but, somewhat aside from this, it is likely that very few shops are in a position to make all-around machinists at all, no matter how long or short they make their apprenticeship. Most shops run to specialties; their foremen and superintendents are specialists and apt to be narrow. The boy who is suited by nature to build rolling-mill machinery, but who gets into a tool shop, is likely to make a failure and go back to the dry-goods counter. This ought to be a strong argument in favor of a trade school whose only specialty will be the teaching of boys along broad general lines. Such a shop school or school shop could have a department building rough heavy machinery, another making something a little better, like machine tools, or high-grade engines, and still another building fine instruments of precision like measuring machines. The apprentice could be put through all these departments, and then finished off during the last year or so in the one for which he showed the greatest aptitude. This would produce a better-graded class of workmen, since each would have a broad experience and would yet be especially skilled in the class of work for which he found himself best adapted. A workman like this could command pay a quarter to a third higher than the best men, provided he did not look out all the time not "to kill his job," as the men say.

Out of five hundred or more different men that have worked for me at one time or another, hardly any did even 50 per cent. of the work which they might just as well have done. The reason is this: Apprentices are, of course, intimately associated with workmen who already have the soldiering disease. This disease is not exactly contagious, since it is a disease of the mind rather than of the body; but, under constant contact, they even come to think of it as the normal state, and to believe those who do not have it are the ones who really need treatment. To eradicate this disease will require years of time, but progress may be made if apprentices are brought up in shops where the journeyman element is absent, or so small and so well selected that its influence will not be bad. That there is a good deal in this was something that I learned on a recent trip to Lynn to visit Mr. Alexander's school. His assistants both called my attention forcibly to the fact that their apprentices advanced faster and did more work by being separated entirely from the journeymen during the first six months than they could possibly do if in contact with men already skilled in the art of soldiering. They showed me a completed jig for boring pulleys, which they stated had been built by boys in less time than would possibly have been consumed in the general machinery shop or tool room just on this account.

Whether this is an impossible dream, or whether it is possible to establish and run a shop for the production of men who shall be well equipped to be machinists without allowing it to develop into a low-grade technical school is something that yet remains to be seen, but until something of the sort is done those shops which would like to give apprentices a fair show will be handicapped in their selection of boys by the kind of shops in which Apprentice served his time.

E. H. FISH.

Apprenticeship and Industrial Education.

W. A. Waterman at page 390 hits the nail on the head very strongly when he says: "The young men of today seem to think that the only thing that will make men of themselves is to smoke cigarettes and drink liquor." This is true in every business as well as that along mechanical lines, but the machinist's trade loses a great many good men because of a deep laid prejudice against the dirty shirt.

Take an ordinary intelligent boy who has a knack for things mechanical, but, who has not developed the necessary love, and offer him the choice of serving his time in a, to him, dirty machine shop, or starting in a bank, and in nine cases out of ten, the boy goes the way water does, viz., the easiest. I know some will say "good riddance," but a moment's consideration will show that the boy is not so much to blame. Probably his mother, sisters, and many of his friends advise the white shirt beginning; it is more "respectable." If the boys could only be brought to understand the truth of the saying, "It is not the clothes that make the man" and, it might be added after looking about us, at the largest industrial captains, "or the money."

When I started to serve my time it was directly against the wishes of my parents and friends, and I owe the fact that I completed it to the best foreman I have ever had the pleasure of working under. Of course these kind friends have long since changed their fronts, and now say, "It was the only line for him."

As has been well and rightly stated, "the best foremen, superintendents, and managers, have to come from the educated of skilled labor." At least here is a place where the college man with his enthusiasm and theory, book knowledge and assurance, has to accept a minor position to that of his boyhood chum, who ten years before had as a foolish boy, started to serve his time—time spent in getting hard wordly knocks, perhaps even losing a couple of fingers, while the evenings found him wrestling with problems which would doubtless make his more fortunate (?) friend smile. However, if he sticks to it, the smile of his friend may become one of respect.

I think the whole success of an apprentice system hinges on the man who selects the applicants, of course the trial term showing clearly any mistake in this choosing.

The self-reliance point is a good one, and I believe can be developed by the loss of a few castings. Give the boy the material, and all necessary instructions and tell him to go ahead with it the best way he can, and if he comes running with a question too often just take a little time, explain clearly what is wanted and ask him how he thinks he could do it. If he cannot think even one way tell him to try for a few minutes and come to you later if he must. The boy will soon get tired of running around for such information, and begin to use his reasoning powers to better advantage.

I heard a little story the other day, which might not be inappropriate here. A well known and respected old gentleman, who goes about this part of the country in rather shabby attire, inspecting his mills and a railroad, which he built out of the necessities, hard work, ambition and experiences of a poor boy, was addressed by a smart, well favored nephew of his, teller in a bank of which the old gentleman is president. This well intentioned individual in a few nicely worded sentences, conveyed the idea to his uncle that it would be better, for all concerned, if he, the uncle, would dress a little "smarter." A twinkle came into the old gentleman's eye as he said, "My boy, I can afford to wear what I please; you can't." NERALCM.

The Inexact Science of Engineering.

Probably the best way to explain the above title is by illustrations showing how the best efforts of engineers or mechanics sometimes result in failures.

The engineer or designer of today finds that it is not enough to be learned both in the technical and in the practical branches of his profession. He must be something of a business man if he would succeed in the subtle process known as "making good." And the good business man is he who correctly foresees the effect of his actions upon the minds of his employers.

It is impossible to tell anyone how to "make good" with his firm, but the following will show how one man failed: A certain designer was doing good work for his firm, and the firm knew it. For his own betterment as an engineer, he kept a note-book, and made many notes. It was not long before he found that his relations with his employers were not as cordial as they had been, and finally he learned that he was looked upon with suspicion. It would be hard to say what line of reasoning led to this attitude toward the designer. Possibly his employers argued like this: "He is taking *our* time to make these notes. Why does he not go forward with something new, instead of writing down what he has done? Perhaps he is considering another position, and wants to use these notes that we are paying for. Perhaps his memory is poor. If so, he will make mistakes. We don't like him." This sounds rather flippant, but I think if the truth were known, many a man has lost ground through a course of action that he thought was sure to raise him in his employers' estimation.

Another illustration will show how another designer succeeded in being on the spot with the thing that people wanted. A safety device was desirable on a machine, to insure breakage at that point if the machine were overloaded, and thereby protect the more expensive parts, and he soon had a device in place. It appeared to one of the mechanics that the device might prove too strong at certain speeds, which it was agreed were those most likely to be used. He suggested trying the device at those speeds, to see if it would really break. But the designer said "No," because he "did not want to strain the parts." Since the device was intended to prevent straining the parts, the conclusion must be that the designer was making what people wanted, but was not particularly anxious to know whether it accomplished the desired result.

At the mechanical end of the business, it sometimes occurs that of two or more pieces of work made in the same way, and with the greatest care, one proves entirely satisfactory, and another is useless. An interesting case of this kind was encountered by those who had to do with the regulation of a large tower clock, which had been famous for its accuracy. The pendulum was hung by a suspension spring, somewhat less than 1/32 inch thick by 5 inches wide, its total length being 12 inches. Two clamps held between two very heavy castings confined the spring and a capstan nut was provided to vary the length of the pendulum rod, which with the ball below made the total swinging portion about 16 feet long and of 700 pounds weight.

The suspension spring was broken, and another one put in its place when the clock refused to keep good time, and led to a good deal of theorizing as to the reason.

Here are some of the faults that might be in the spring and cause irregularities in the motion of the pendulum: Unequal tension in the spring would cause the pendulum to swing different distances at different times, especially with varying temperatures. If some parts of the spring were stiffer than others, the spring would not bend equally throughout its length, and this action might easily affect the swing of the pendulum, and again, if there were hard and soft spots in the spring, the pendulum might swing in a crooked arc, or even deflect a little to one side at the point of reversing its motion at either end of the swing.

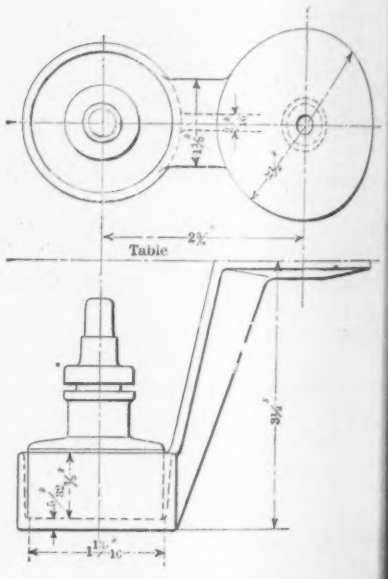
Of course, none of these defects would noticeably affect the pendulum in one pulsation, but after a few thousand beats the multiplied variation would certainly show on the clock face. The trouble was overcome by putting a third spring in place of the second, and the clock again kept good time. These springs were made as nearly alike as possible, and only two of the three were good springs, which was a poor showing according to modern standards of manufacture.

R. W. BEALE.

An Ink Bottle Holder.

I have noticed in your columns a number of different methods of holding the drawing-ink bottle, some of which have been very good, but I have never seen any that quite equals the one I am about to describe.

This holder is made to hold one of Higgins' bottles and is fastened to the under side of the drawing-table by one screw so that it may be swung in underneath out of the way, as shown in the sketch. We have these attached to all our tables and find them very handy.



AN INK BOTTLE HOLDER.

They have the advantage over all others in that they are always where they are wanted, and are never covered up by a multitude of drawings and their position eliminates all danger of spilling their contents, or of drippings from the filler getting on the drawings.

JOHN EDGAR.

The *Zeitschrift des Vereines Deutscher Ingenieure* is publishing a series of articles, copiously illustrated, upon the famous Italian genius, Leonardo da Vinci (1452-1519), artist, scientist, engineer, mechanician, musician, etc. The *Zeitschrift* contains cuts and descriptions of a great number of the mechanical devices brought forth by da Vinci's active mind.

It is reported that the Napier Company in England is constructing a six-cylinder motor-car in which the change-gear method of speed contol is done away with, the thottle and spark regulation being depended on altogether.

Convention of the National Machine Tool Builders' Association, at Atlantic City.

The spring convention of this association was held at the Chalfonte, Atlantic City, N. J., May 1 and 2, and was very well attended, many of the delegates being accompanied by their wives, and all present finding the occasion an interesting and enjoyable one. In fact, the meeting proved to be one of the most satisfactory and valuable conventions yet held by the association.

As most of our readers know, this organization maintains a healthy growth, its members steadily increasing in number from year to year, and it is its hope and desire that eventually all American tool-building concerns may be gathered into its ranks. The association at present includes nearly sixty establishments, no less than six having been admitted to membership at this last convention.

The first session, Tuesday morning—like most sessions of this organization—was executive, and routine business occupied a greater part of the time preceding the adjournment for luncheon. During the afternoon the various committees made up of the manufacturers of the different lines of tools held special meetings at which were considered various matters of interest coming particularly within the folds of the individual sections of the association.

INCREASE IN PRICES OF TOOLS.

Among the questions coming before the different departments or committees to be worked out before reporting to the convention as a whole was the matter of prices. In regard to the three items of lathes, planers and shapers there is to be a general advance made by members of 5 per cent. over the present resale or purchasers' price; and upright drill prices are also to be advanced over the present resale price by from 5 to 10 per cent. This matter of drill prices was arranged at the recent special meeting of the upright drill makers at Chicago, their report being handed in and ratified at this general convention at Atlantic City.

DISCUSSIONS.

On Wednesday morning E. P. Bullard, Jr., presented a paper on the Apprenticeship System, in which were considered a great many points bearing on the training of boys in the shop, the relations of employers and apprentices, etc. This paper, which will be published later, brought out an interesting discussion, and the committee on the apprenticeship question is to continue its efforts toward discovering what can be done to establish something like uniformity among the various shops in dealing with the apprenticeship situation.

Another topic discussed at length was that of a minimum profit and cost system, and a committee was appointed to make an investigation looking toward the establishment of some system whereby the true cost of machine tools may be determined. This committee will report at a later convention.

NEW MEMBERS.

As stated above, six new members have just come into the association, and these are as follows:

Niles-Bement-Pond Co., New York; Cincinnati Machine Tool Co., Cincinnati, Ohio; W. F. & John Barnes Co., Rockford, Ill.; Rockford Machine Tool Co., Rockford, Ill.; Mechanics' Machine Co., Rockford, Ill.; Dwight Slate Machine Co., Hartford, Conn.

Practically the whole of both days at Atlantic City was devoted to the work of the convention, and no excursions or side trips were taken by the delegates in a body, the various committee meetings and the general sessions of the organization occupying the entire time mapped out on the program. The entertainment committee however, arranged an automobile trip about the city for the ladies in the party which was of course highly appreciated. The next convention of the association is to be held in New York, probably in the month of October.

REGISTER OF MEMBERS AND VISITORS.

P. E. Montanus, Springfield Machine Tool Co., Springfield, O.; W. P. Davis, W. P. Davis Machine Co., Rochester, N. Y.; E. M. Woodward, Woodward & Powell Planer Co., Worcester, Mass.; H. J. Hendey, Hendey Machine Tool Co., Torrington, Conn.; C. H. Alvord, Hendey Machine Co., Torrington, Conn.; Aug. H. Teuchter, Cincinnati Machine Tool Co., Cincinnati, O.; B. B. Quillen, Cincinnati Planer Co., Cincinnati, O.; J. B. Doan, American Tool Works Co., Cincinnati, O.; C. H. Norton, Norton Grinding Co., Worcester, Mass.; F. E. Reed, F. E. Reed Co., Worcester, Mass.; Chas. E. Hildreth, Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.; H. L. Flather, Flather & Co., Inc., Nashua, N. H.; Henry B. Binsse, Binsse Machine Co., Newark, N. J.; Israel H. Johnson, Jr., I. H. Johnson, Jr., Co., Phila., Penn.; Murray Shipley, Lodge & Shipley Machine Tool Co., Cincinnati, O.; Richard K. LeBlond, R. K LeBlond Machine Tool Co., Cincinnati, O.; A. E. Newton, Prentice Brothers Co., Worcester, Mass.; O. M. Flather, Mark Flather Planer Co., Nashua, N. H.; E. Rivett, Rivett Lathe Mfg. Co., Boston, Mass.; Fred A. Geier, Cincinnati Milling Machine Co., Cincinnati, O.; Wm. A. Greaves, Greaves, Klusman & Co., Cincinnati, O.; H. O. Hoefinghoff, Bickford Drill & Tool Co., Cincinnati, O.; H. W. Breckenridge, Colburn Machine Tool Co., Franklin, Penn.; V. F. Hatch, Builders Iron Foundry, Providence, R. I.; C. E. Whitney, Whitney Mfg. Co., Hartford, Conn.; A. M. Whitcomb, Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.; F. L. Eberhardt, Gould & Eberhardt, Newark, N. J.; W. D. Woolson, Jones & Lamson Machine Co., Springfield, Vt.; E. D. Westrip, Rockford Machine Tool Co., Rockford, Ill.; Geo. J. Burns, Chandler Planer Co., Ayer, Mass.; C. J. Wetsel, Baush Machine Tool Co., Springfield, Mass.; Geo. O. Gridley, Windsor Machine Co., Windsor, Vt.; Geo. F. Stewart, Bradford Machine Tool Co., Cincinnati, O.; E. P. Bullard, Jr., Bullard Machine Tool Co., Bridgeport, Conn.; A. L. Whitney, Whitney Mfg. Co., Hartford, Conn.; C. A. Hoefer, Hoefer Mfg. Co., Freeport, Ill.; Geo. A. Lautz, Niagara Machine & Tool Co., Buffalo, N. Y.; A. T. Anderson, National Supply & Machinery Dealers' Association, Cleveland, O.; F. H. Brown, Brown & Zortman, Pittsburg, Penn.; John A. Hill, Hill Publishing Co., New York; A. F. Chamberlain, Westinghouse Electric & Mfg. Co., Cincinnati, O.; Alex. Luchars, *Machinery*, New York; H. Prentiss, Prentiss Tool & Supply Co., New York; Fred. W. Schultz, *Iron Age*, New York; John Nelson, *Iron Age*, Worcester, Mass.; Frank Bancroft, Manning, Maxwell & Moore, Phila., Penn.; A. C. Hawkins, T. R. Almond Mfg. Co., Brooklyn, N. Y.; D. C. Warren, *Iron Trade Review*, New York; A. Van Zwaluwenburg, *Iron Trade Review*, New York; J. McGhie, Wm. R. Wallace, Nathaniel C. Robbins, Fred. S. Weatherby, F. A. Stanley, AMERICAN MACHINIST, New York.

Discussion on Industrial and Technical Education.

The Graduates' Club of this city, held a meeting the evening of April 27 for the discussion of industrial and technical education, which was well attended and addressed by several leading educators and others.

The first speaker was Hon. Thomas C. Monaghan, of the Department of Commerce and Labor. Mr. Monaghan was at one time a consul in Germany, where he made an extended study of the industrial schools of that country, and his address related chiefly to them. He pointed out that Germany is poor in industrial resources, and that the tremendous strides of that country can be chiefly attributed to the attention given during the past 75 years to the subject of industrial and industrial art education. He considered that our own progress was chiefly due to our great resources, rather than to their intelligent use, and strongly deprecated American conceit.

Dr. Thomas M. Balliet, Dean of the School of Pedagogy, New York University, called attention to the fact that we have now a sufficient supply of engineering schools of the higher grade, but that of technical schools of a lower grade we have almost none. He also had made a study of the German schools and was impressed with the practical character of their instructions, giving as an illustration

of his observations the manner in which arithmetic is taught in those schools. This subject, he said, is not taught in a scientific way at all, but the teaching goes straight at the mark and confines itself to the uses of arithmetic in the trades taught. About three-quarters of the teaching is devoted to application and one-quarter to science, whereas with us this ratio is reversed, and the applications that are taught in our schools are more accidental than otherwise. He criticized the work of our evening schools and considered that it must be largely recast. He stated that as a result of such recasting the attendance could be easily doubled. He felt that the starting point in this recasting should be the adaptation of the instruction given to men who are already earning a livelihood, and who desired specific instruction relating to their trades.

Ernest E. Yalden, superintendent of the Baron de Hirsch Trade School in this city, devoted his attention chiefly to trade schools of the class with which he is connected. The aim of this school is not to turn out competent journeymen, but to give such instruction as will enable its graduates to make an effective start in commercial establishments. With this in view, the course of instruction is made short—about 5½ months—and he considered this necessary because of the sacrifice on the part of those who attend the school.

Prof. Milton P. Higgins, of the Norton Emery Wheel Works, enlarged upon the difficulty of securing competent mechanics, and then went on to say that he had been listening to discussions and reading reports on this subject for 30 years. They all reach the same conclusion, that we need a system of schools to correspond with those in Germany, and there they stop. He considered that we had had enough of discussion, and that the time for action had arrived. What the country needs is skilled workmen, and the aim of such schools should be to impart skill first and scholastic knowledge second. He believes that the present work of the public schools was well done, and that the trade schools should be co-ordinated with them.

Magnus Alexander, of the General Electric Company, Lynn, Mass., described the apprenticeship system and trade school of the General Electric Company at Lynn, with which he is connected, and of which we have already published particulars at page 416. He considered it a mistake to assume, as some of the previous speakers had done, that the system of apprenticeship is dead. He said that his company paid the highest wages to apprentices that are paid anywhere to his knowledge, these figures being $4.50 per week for the first six months, with an advance of a dollar a week for each later period of six months.

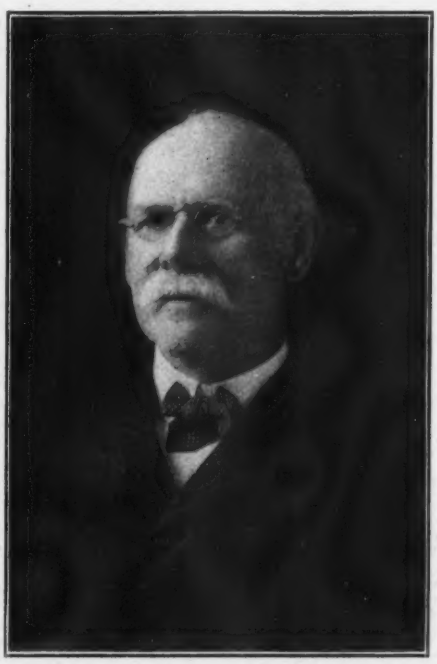
Prof. Chas. R. Richards, of Teachers' College of this city, considered that the chief problem was economic rather than educational. Of course, the question of school organization is difficult, but it is easy in comparison with the greater problem of support by the students when undergoing their education. He referred to the report of the Massachusetts Industrial Education Commission, which had paid especial attention to the case of boys leaving school at 14 years of age, and connected this with the fact that high-class trades do not receive boys under 16, and in some cases 17 years. The Commission had paid large attention to this class of boys and had concluded that the intervening two years are largely wasted.

Arthur Dean, the director of industrial education for the Y. M. C. A., made further reference to the Massachusetts report. He said that the line of employment which boys enter is, as a rule, determined by chance, and that the class of boys who leave school at 14 go, as a rule, into low-grade industries. The Massachusetts commission had followed up the cases of about 5000 boys of this class and had found this to be the case. Moreover, the commission had found that at the age of 20 the wages earned were substantially the same for those leaving school at 14 as for those who left at 16. That is to say, the two years spent in school contributed as much toward earning capacity as two years' experience did. The commission had found that of those leaving school at 14 only 2 per cent. entered the high-grade industries.

Following the set addresses, as very briefly abstracted above, a general discussion took place.

David O. Paige.

David Osgood Paige, manager of the Pfaudler Company, Rochester. N. Y., makers of glass-enameled steel tanks, died at his home, 150 Canfield avenue, Detroit, Mich., April 10.



DAVID OSGOOD PAIGE.

Born at Weare, N. H., Sept. 14, 1833, he received his early education in the schools of Manchester, N. H., and later graduated from Andover College. He showed a natural aptitude for mechanical work, and at the age of 19 was foreman and contractor in a machine shop in Lawrence, Mass. In 1865 he went to Detroit, where with others he organized the Detroit Safe Company. While engaged in the manufacture of safes and vaults, Mr. Paige became interested in glass-lined steel tanks and designed a line of special machinery to make them. The Pfaudler Company was then formed with a factory in Detroit, which four years ago was moved to Rochester. This factory is considered a model of its kind. Mr. Paige was the inventor of many devices, among others a large flange-rolling machine described at page 439, Vol. 28. He also invented the steel-flange safe which is now universally used in the manufacture of fire- and burglar-proof safes.

The adulteration of india rubber appears to have assumed the proportions of a large and highly scientific industry, says a writer in the *Times Engineering Supplement*. The demand for this substance for a long time past has been increasing at a rate wholly out of proportion to the sources of its supply, and consequently many minds have been occupied with the endeavor to manufacture an efficient rubber substitute, or in the shape of "regenerating" old rubber or "improving" new by the addition of various compounds—zinc oxide, chalk, antimony, and so forth—to increase the available stock of this commodity now so sought after by the world. Although the producer of an artificial india rubber would be rewarded with a gigantic fortune, no nearer approach seems to have been made toward this consummation than the production of various forms of oxidized oil. The chief fault of artificial rubber has been lack of toughness and also elasticity. Otherwise some of the experiments have seemed promising. If these last two qualities could be secured, we might see some abatement in the present method of "improving" the natural product by the addition to it of various materials alleged to have a beneficial effect upon the substance, which, however, is apt to be more perceptible to the seller than the buyer of adulterated rubber.

Another great vessel, the "Kaiserin Auguste Victoria," of the Hamburg-American fleet, has just been added to the rapidly increasing list of North Atlantic liners. She is 700 feet long, 78 feet beam, and has no less than eight decks above her water line. Her displacement is 43,000 tons, and she will carry a crew of 559 officers and men.

The Chattanooga Meeting of the American Society of Mechanical Engineers.

The opening session of the 53d meeting of the American Society of Mechanical Engineers was held in the auditorium of the Masonic Temple in Chattanooga, instead of in the auditorium of the Read House, the program having been changed in that respect.

At 9 o'clock there was an audience of about two hundred, who listened to a remarkably appropriate address of welcome by Mayor Frierson, of Chattanooga, who was introduced by Newell Sanders, chairman of the Local Committee.

Mayor Frierson spoke of the various epochs of the world's history, referring to periods when the achievements of the world were in the lines of military glory, of art, and of letters. He referred briefly to the men who distinguished themselves, and who made the history of the times in which they lived, finally coming down to the present day in which he called attention to the fact that it is the engineer who is preëminent, and who is determining the course of development and progress. And in doing this he is not copying old masters, and hoping to equal them, but doing new creative work in previously unexplored fields.

To say nothing of the eloquence of the speaker, it was generally agreed that Mayor Frierson's remarks showed a thorough and comprehensive grasp of the subjects of which he spoke.

The response of President Taylor was equally appropriate. He said that engineers were looking to the South as a field to be developed industrially; that engineering and engineers know no sections—no North, no South, nor East, nor West. They have no prejudices, but seek opportunities for carrying on their work where it may be best carried on; the opportunities for such work seeming now to be more abundant in the South, perhaps, than in any other section of our country.

At the close of the addresses, both of which were short and directly to the point, there was a reception which was a pleasant affair, and which closed the proceedings for the evening.

At this time it seemed evident that the attendance at the meeting was not to be as large as had been expected, the total registration up to Tuesday evening being only slightly over 100.

WEDNESDAY MORNING SESSION.

The first, or business, session was opened by the reading of the report of the tellers of election by the secretary.

Following this a change in the By-Laws was proposed by Jesse M. Smith, changing slightly the details of expenditure.

Following this again, came a report of the architect of the new Engineering Building, which was dated April 26, and hence gave an account substantially correct at the date of the meeting of the degree of progress of the building, which was considered very satisfacory.

An invitation was then read by the secretary from the Board of Governors of the Jamestown Exhibition, inviting the society to hold its spring meeting of 1907 in Norfolk. This exhibition commemorates the 300th anniversary of the first English settlement in this country. The invitation was referred to the Council.

Two changes in the Constitution were then proposed, one by Mr. Hunt, and the other by Jesse M. Smith. The former authorized the Council to appoint an honorary secretary, and the latter authorized the appointment of a research committee to consist of five members—one member to retire each year. By the terms of the Constitution amendments to it can only be voted upon after six months preliminary notice, and the action at this meeting only gave that preliminary notice.

Following this the reading of papers was taken up, the first being the

REPORT OF THE COMMITTEE ON STANDARD PROPORTIONS FOR MACHINE SCREWS.*

This report was presented at the New York meeting of the society last December but in order to give further opportunity for examination and discussion was laid over until the present convention.

The report is the outgrowth of a paper read before the society some years ago by C. C. Tyler, in which attention was called to the chaotic condition of our small machine screws. The committee consists of Wilfred Lewis, chairman, Charles C. Tyler, Horace K. Jones, John Riddell, George R. Stetson, George M. Bond, who acted in concert with several machine-screw manufacturers. The thoroughness of the report is indicated by the fact that it discusses and decides upon the following details which the committee believe to be essential in establishing and maintaining the desired standards:

Form of thread.

Diameters.

Number of threads per inch.

Standard reference thread gages, basic and for screws and taps.

Working gages for screws and for taps.

Limits of variation, measured in the angle of the thread.

Limits of variation in external diameter.

Limits of variation in the pitch of thread, screws and taps.

Proportions of the heads.

The Sellers form of thread is adopted, except that the screws and taps are to be so made that the threads will clear one another at top and bottom, the bearing being only on the sides, as it should be. The range of sizes is from and including .07 to .375 (3/8) inch, and it thus overlaps the Sellers sizes between 1/4 and 3/8 inch. The latter size has the same number of threads as the Sellers standard, but the smaller sizes are finer, as they should be. It is well known that the smaller sizes of Sellers threads are not used to nearly the extent of the larger ones, and we cannot but think that this is a very favorable opportunity to revise the smaller Sellers sizes for bolts and to adopt those which people will use and to make the sizes for bolts and screws uniform.

To carry out the clearance of top and bottom idea the committee adopts Mr. Tyler's suggestion and recommends three sets of reference gages—one basic one for screws and one for taps—and, with slight modifications, other recommendations of Mr. Tyler's are adopted.

Detail engravings of these master gages are given, and the form of working gages is also determined. Recognizing the necessity for variation in the sizes of manufactured screws, limits of variations for taps and screws are established by formulas and exhibited by enlarged diagrams. Complete tables of these limits are also given, the report concluding with tables of recommended standards for round, flat fillister, oval fillister and flat heads.

The report was discussed by Mr. Burlingame, as it had been discussed by him six months ago, and he still felt that in its present form the report was not entirely satisfactory. He regarded the threads provided as too sharp for the small sizes, in that they did not provide sufficient wear for the taps. The diameters do not represent any existing list, and are not, as they should be, in geometrical progression. Mr. Burlingame felt that either existing sizes should be followed, or that, if they were discarded, the new list should be in geometrical progression. He referred to the use of the screw thread micrometer caliper as made by the Brown & Sharpe Manufacturing Company, and considered that it should be included in the report. He considered that this instrument had made possible the present degree of accuracy in screw threads. He also criticized the standard proposed for the screw-driver slot. This detail is already standardized, and the existing standard should be followed.

On motion the committee was continued, and requested to take these suggestions into consideration, and to report again at the fall meeting.

The next paper to be taken up was the

REPORT OF COMMITTEE APPOINTED TO CO-OPERATE WITH THE PENNSYLVANIA RAILROAD SYSTEM IN CONDUCTING TESTS OF LOCOMOTIVES AT THE LOUISIANA PURCHASE EXPOSITION.

It will be recalled that, preliminary to

*Any of these reports or papers may be obtained at small cost by addressing the secretary of the society at 12 West Thirty-first street, New York.

the great series of tests conducted by the Pennsylvania Railroad at St. Louis Exposition, the officials of that company invited the society to appoint a committee to co-operate in conducting the tests, and that that invitation was accepted. The present paper is a report of that committee, and it gives the more general results of the tests. A similar invitation was extended to the American Railway Master Mechanics' Association, and it is understood that that committee will render a report to its association, which will be substantially a duplicate of this one.

The report was discussed by E. G. Bailey, who thought that the methods of sampling the coal were not satisfactory, although they were the usual methods followed. He described methods used by himself, by which much more concordant results could be obtained.

Following this came a paper on the

Effect of a Blow.

By A. W. Moseley and J. L. Bacon.

Having occasion some months ago to measure the pressure exerted by an embossing press the authors of this paper standardized some copper plugs in order to measure that pressure and as it occurred to them that similar methods might be applied to a much greater extent than at present to measure the effects of machines and especially of hammers, they offer the paper as a suggestion in that direction. They have applied their own suggestion to the measuring of the effect of the blow of a Bement-Miles 200-pound steam hammer, and give in their paper the results of this test, and also a calibration curve of the plugs as tested under a testing machine.

This paper was discussed by Professor Jacobus, who thought that the analysis of the paper was defective, and that while the method was fundamentally sound, the experiments and analysis were not sufficient to enable it to be used.

The next paper was

A History of the Introduction of a System of Shop Management.

By James M. Dodge.

This paper was originally presented at one of the monthly reunions of the society during the past winter, an abstract of it having been given at page 326, and it is unnecessary to repeat that abstract here. In its present form the paper includes the discussion which took place at the monthly reunion; this discussion including a good deal of explanatory matter by Mr. Taylor, the author of the system referred to.

This paper was discussed by Mr. Henning, who said that it pointed out for the first time the possibilities of economic machine shop production, and that it opened up great possibilities. He considered that it would have a great effect in the future.

Next on the list was a paper on the

Collapsing Pressures of Bessemer Steel Lap-welded Tubes 3 to 10 inches in Diameter.

By R. T. Stewart.

This paper presents a piece of research work of the highest order of interest and importance. Engineering literature contains many formulas for the collapsing strength of tubes, most of which are based upon the classical experiments of Fairbairn, which were made more than half a century ago, and upon tubes wholly unlike the modern product. For the first time in half a century these formulas are compared with new experimental results, and the comparision shows that the old formulas are practically worthless—the first tube tested in these experiments failing under a pressure that exceeded by about 300 per cent. that calculated by means of Fairbairn's formula. The paper says in its first paragraph that every means known to engineering science that could aid in the accomplishment of this undertaking has been used, and every possible effort made to get at the truth and have the research yield trustworthy data. An examination of the paper fully bears out this statement. It comprises 87 pages with a wealth of tables and diagrams that show the experiments to have been complete and exhaustive to a degree which places engineers in possession of all the data necessary for work of this character. The results of the experiments are arranged for practical use in the form of formulas, diagrams and tables. The paper also contains many other diagrams, in which the results of the experiments are compared with the various formulas which have been based on Fairbairn's experiments.

In presenting his paper the author said that the experiments had been undertaken as a result of attempts to calculate the collapsing strength of tubes by various existing formulas which gave such discordant results that the experiments were eventually undertaken. He pointed out especially that the collapsing pressure does not appear to depend upon either the ultimate strength or the elastic limit of the material, but solely upon the modulus of elasticity.

In discussing the paper Mr. Henning regarded the paper as of the first order of importance, as did several other speakers, the paper being regarded as one which in every way reflects great credit upon the society. Mr. Henning regarded the yield point of the material as of importance, because it determined the point at which the tubes began to fail, after which beginning complete failure was almost instantaneous. He referred to the fact which is brought out in the paper that in many cases the tubes failed at about two feet distance from one end and considered this to be due to internal stresses.

The author replied to Mr. Henning and reasserted his conclusions that the yield point had nothing to do with collapsing pressure, for the reason that the yield point was not reached in a single one of the tubes tested. He regarded the failure at two feet from the end to be due to the fact that examination of the tubes showed their departure from a true circle to be in many cases the greatest at this point, and, of course, other things being equal, the point of greatest departure from the true circular form would determine the point of failure.

Mr. Rice, chairman of the Committee on Papers, considered the paper so valuable that it deserved special recognition by the committee.

Mr. Sweeney referred to the rule of the Board of Supervising Inspectors of Steam Vessels which makes the strength of the tube depend on its length, and asked the author if he had compared the results of his experiments with this formula. This Mr. Stewart had not done, but he was satisfied that any formula in which the length of the tube is a factor must be erroneous after the tubes have passed a length greater than six or eight diameters, beyond which point the length has no appreciable influence.

The discussion was closed by President Taylor, who also commended the paper in the highest possible terms.

The next paper to be taken up was

A Low Resistant Thermo-Electric Pyrometer and Compensator.

By W. H. Bristol.

This paper was originally presented at one of the monthly reunions of the society during the past winter, an abstract of it having been given at page 201 and hence it is unnecessary to give an abstract here. The paper as now offered contains the discussion which took place at the monthly reunion, the remarks of several speakers being highly instructive and also in several cases extremely complimentary to the pyrometer of Professor Bristol. There seems to be no doubt that his instrument is a very satisfactory solution of the high temperature measuring problem, and that it has a very large field of usefulness before it.

In presenting his paper Professor Bristol referred to some experiments which he now has in progress, by which the instrument will be made to measure temperatures as high as those which can be reached by the Chatelier instrument. These experiments refer to a compound couple composed partly of platinum and rhodium as used in the Chatelier instrument, and partly of the cheaper materials used in Professor Bristol's instrument, the expensive metals being in a short section only, and hence costing less than in the Chatelier form. He also describes experiments he has in progress with every promise of success for making a frictionless recording instrument. In this instrument the record paper is smoked,

and, normally, is kept at a distance of one-sixteenth of an inch from the index pointer, but at intervals of ten seconds the paper is brought to contact with the index and impressions are thus made, which are close enough together to form in effect a continuous line. A simple method of fixing the impression has been devised. In reply to a question by a member, Mr. Stewart explained that his method of calibration was by reference to the melting points of metals and by the use of a standard Chatelier instrument.

The last paper of the session was on

A New Liquid Measuring Apparatus.

By George B. Wilcox.

This paper describes an apparatus which was originally designed to automatically measure brine flowing from a salt well into a salt works. After about a year's satisfactory operation in that capacity, tanks of the same type, but modified in detail, were designed and set up as a permanent part of a boiler-room equipment to automatically measure and record the amount of feed water supplied to boilers, and it is for such uses as this that the apparatus is offered to the public in this paper. The operation of the apparatus is claimed to be free from the numerous errors of water meters, and to be much more desirable than weighing tanks, inasmuch as it saves the labor involved in operating weighing tanks. It has also been found to be extremely accurate, the maximum error when used as a feed-water weigher having been found to be less than one-quarter of one per cent. after four months' constant use.

The paper was discussed by Professor Jacobus, who referred to the very small percentage of error claimed for the instrument, and asked if the tests were made at various speeds, as in that event he regarded the accuracy of the apparatus as remarkable. He would expect a much larger variation than that given, provided a variation in the velocity took place. Another speaker considered the apparatus as of a very high degree of usefulness.

WEDNESDAY AFTERNOON.

At two o 'clock special trolley cars drew up in front of the Read House, and conveyed the visitors through a manufacturing section of Chattanooga to the base of Lookout Mountain, and to the foot of an inclined cable railway which has been constructed to take visitors to the top of this, the most interesting mountain connected with the history of the Civil War.

The summit of Lookout Mountain is 2000 feet above the city of Chattanooga, which itself is on an eminence of considerable hight above sea-level.

The cable railway leading to the top is believed to be the longest, and probably is the steepest grade in this country; parts of it being of 66 per cent. gradient. As the steepest portion of it is near the top, it gives those unaccustomed to it a considerable sensation to look down from the cars with apparently nothing between themselves and the distant base of the mountain.

From the top one of the most magnificent views to be seen anywhere in the country is spread out under the spectator's feet. The Indians called this the "far look" mountain, and made much use of it in their primitive, though effective military operations. As our readers know, the mountain and vicinity figured largely in the history of the military operations of the Civil War; and the battles fought upon and about this mountain had a marked effect upon the outcome.

Many of the special points of interest have been marked by monuments; and there are also numbers of tablets reciting the history of the strenuous events which took place here 43 years ago.

Fortunately, Gen. H. Clay Evans, well known throughout the country, especially in connection with his work as Commissioner of Pensions, whose home is in Chattanooga, and who is familiar with the historical points of the vicinity, accompanied the party. Upon the point of the mountain he was prevailed upon to address the assembled members, which he did in an exceedingly acceptable and interesting manner; pointing out, as he spoke, the geography of the military operations; and, finally, remarking that if his hearers wished to know anything more of the war, the Government had published a history of it, comprised in 125 volumes.

The Lookout Inn, which stands upon the summit of the mountain, attracted the attention of the members, and the refreshing breeze and good air prevailing in that locality caused many suggestions to the effect that probably the next time the society holds a session in Chattanooga, headquarters will be at this hotel instead of at the Read House, which last is not particularly popular with the members.

Descending about five o'clock, the party returned to the hotel to prepare for the evening reception which was held in the auditorium of Masonic Temple, Wednesday evening, instead of Thursday evening in order to give the visitors opportunity to attend the Damrosch concert, and at the same time enable citizens of Chattanooga to attend both functions. Needless to say the reception was as usual a brilliant and very much enjoyed affair.

THURSDAY MORNING'S SESSION.

There was a delay of half an hour in the opening of the session, which was to have taken place at 9:30, according to the program. At the beginning of the proceedings the program was reversed, and the paper by Thos. E. Murray presented first. This was entitled

The Improvement of the Tennessee River and Power Installation of the Chattanooga and Tennessee River Power Company, at Hale's Bar, Tenn.

By Thos. E. Murray.

This paper describes the characteristics of the Tennessee river, and the efforts that have been made by the general government for improvement of it as a navigable stream. The development of electric power stations driven by water power led some of the business men of Chattanooga to conceive the idea that the work for the amelioration of the traffic conditions on the river might be made to pay for itself by the conversion of the water power generated at the dam into electrical energy, and after suitable examination, the idea was found to be feasible, and an act of Congress was obtained, authorizing the construction of such works, which are now in progress.

The paper describes the contemplated work in considerable detail, and sets forth the difficulties of the problem, due to the large variation in head and volume of water at different seasons of the year. In order to meet the necessity for continuous operation and uniform speed under these varying conditions, a novel form of plant has been designed by John Bogart, which consists of a vertical turbine shaft, having upon it three turbines. Under ordinary stages of the river only two of the turbines will be used, the third being held in reserve and used when there is a large quantity of water flowing, but giving a reduced head. The entire plant is expected to be completed and ready for operation about October 1, 1907.

In presenting the paper Mr. Orrok stated that the Tennessee river is navigable for steamers through 1300 miles of its length; but that it drains an area of only 44,000 square miles—a drainage area rather small for a river of its length. At various times Government engineers had considered the feasibility of improving the river for navigation purposes; but it had not been considered feasible to do so, chiefly on account of the expense involved. Finally, however, it was recognized by business men of Chattanooga that the expense of improving the river for navigation could be made to pay a return by so arranging the improvements as to derive power from the river. First the opportunity was given for the city of Chattanooga to control this matter; but, the city not availing itself of the privilege within the specified time, private parties took it up.

Figures were given showing the comparison between the Tennessee river and other large rivers of the country, and bringing out the fact that its flow of water at the point where these improvements are being made is considerably greater than is the flow of any other river at a point where it is being or has been dammed for a similar purpose.

Maj. H. C. Newcomer, who has taken a prominent part in this work, gave a number of interesting facts connected

with it, from which it was made apparent that this improvement is, in many respects, unique; and that the problems handled by the engineers in charge are different from and more difficult than any other similar problems connected with analogous undertakings. Among other things, it was stated that the strain upon the dam will be greater than that upon any other similar dam in an American river.

A number of questions were asked by members, all of which were satisfactorily answered by engineers connected with the work; among others, H. M. Lane asked if the effect of the probable denudation of the forests adjacent to the headwaters of the Tennessee had been considered with respect to its effect upon the run-off of the river. It was explained by Mr. Guild that the timber in this section of the country was quite varied in character; and that, on this account, the methods of the lumbermen were different from those usually followed. The practice is for the lumberman to go in for a certain kind of lumber only, so that he cuts out only a tree here and there, amounting to only a few per acre. Some years afterward other trees may be cut out; but, in the meantime a new growth has sprung up; and the ground is never, therefore, made bare. It was believed that this condition would be maintained for a long time to come.

Mr. Burlingame referred to what is being done by the Government on behalf of forest preservation in the White Mountain and the Appalachian regions; and thought that this might have a bearing on the forests in the headwaters of the Tennessee. His remarks led to the introduction of a resolution authorizing the president to appoint a committee to consider the matter, and to take such action on behalf of the society favoring the preservation of the forests as might seem appropriate and proper.

At the close of the discussion, Secretary Hutton called attention to the fact that this paper had been presented to the society in two forms—the regular form, and also in the form of a souvenir book, dealing with Chattanooga and the river improvements generally; that this book, splendidly illustrated and printed, had been gotton up by Mr. Murray at his own expense as a gift to the members; and he considered, therefore that a vote of thanks would be proper; which vote of thanks was adopted by acclamation.

Mr. Replogle, in the course of the presentation of this paper, spoke of the difficulties that had been overcome in the work; and, among other things, said that, had he understood the facts now shown by the diagram Fig. 1 of his paper, which illustrates the work to be accomplished by a satisfactory water-wheel governor, he would have given up the problem fifteen years ago. It was, as he said, a case where it seemed that ignorance was bliss.

Following Mr. Replogle's presentation of his paper, Secretary Hutton called attention to the fact that the hour was getting late, and that, in order to attend the excursion during the afternoon, it would be necessary for the meeting to close promptly on time. He therefore moved that the remaining papers be read by title only, and that they then be discussed together. The resolution was carried, but no discussion ensued. Following are extracts of the papers read by title:

The Regulation of High Pressure Water-Wheels for Power-Transmission Plants.

By Geo. J. Henry, Jr., San Francisco, Cal.

This paper is entirely a discussion of methods of regulation for water-wheels of the Pelton type. The great danger and inconvenience which would result from the rupture the pressure pipe carrying a large volume of water at a pressure of from 200 to 1000 pounds per square inch, is first spoken of; hence it is exceedingly desirable to avoid in the regulation of the wheel the causing of much variation in the velocity in the pipe line, and the consequent water ram every time the governor checks the velocity. Safety valves to guard against this danger are not reliable because they are liable to become frozen up or become stopped up with leaves, sticks, etc. The Pelton wheel, however, readily lends itself to a construction utilizing a deflection of the stream of water from the buckets in order to reduce the load that the wheel will carry, at any instant of time. Such deflection can readily be accomplished without interfering with the spouting velocity of the water from the nozzles by merely diverting the stream off or on to the bucket. This can be done by pivoting the nozzles, or the nozzles can be made rigid, and a stream deflector introduced into the jet in front of the nozzle tip. A reproduction of a photograph, showing the jet of water acting on the buckets of a wheel is shown. Also a picture of a model of a pivoted deflecting nozzle, moved up and down by means of an automatic governor. A view is also presented of a triple nozzle for Pelton wheels, having cut-offs fitted to each outlet. The cut-off, however, has the same disadvantage as a turbine gate in that it exposes the pipe line to shock.

The custom in recent years has been to use a combination of a deflecting nozzle and a needle valve in the nozzle itself. This type of apparatus is illustrated, one of the pictures being an interesting one, showing the jet issuing from the nozzle, the needle projecting beyond the aperture being visible in the interior of the jet, as a dark conical mass. The practice followed in using this mechanism is, each hour to set the nozzle to a point that will allow an opening sufficient for the maximum or peak load which may be expected during that hour, and the governor is allowed to take care of the fluctuations below this point by varying the position of the nozzle so as to allow more or less of the jet to impinge upon the buckets. As the nozzles for the large units which are at present customary are of considerable weight, counterbalancing cylinders are introduced beneath them, being supplied by pressure either from the governor oil-pump system, or from the main pressure pipe line. A diagram is presented showing the amount of water which would be consumed under different systems of governing.

Another method of avoiding shocks on the pipe line while using a needle nozzle, is to cause the governor to operate both the nozzle and an automatic by-pass valve, by which the surplus water left when the nozzle opening is reduced, is allowed to continue flowing but in a direction which keeps it from running on to the wheel. A drawing is presented showing the arrangement for operating such a device. However, the deflecting nozzle is considered as a more desirable device, and conductive to great safety of the pipe line. With the use of tension rods and bell-cranks, etc., for operating the deflecting nozzle, there is considerable lost motion, the result of which is to cause a certain amount of hunting in the governor. This is avoided by dispensing with all these connections and placing a pressure cylinder immediately below the nozzle, connecting it thereto by a pair of links. The flow of the oil or pressure fluid to the upper or lower ends of the regulating cylinder is controlled by means of a piston valve, subject to double control, on the one hand from the position of the balls of the governor, and on the other hand, from the position of the nozzle itself. Still another control element is sometimes introduced in the shape of an electric motor controlled by push buttons from the switchboard, so that two or more units can be regulated by the man at that point, by merely pushing the button, the effect being to cause the little motor to regulate the position of the piston valve independently of the other forces acting upon it, and therefore to control the position of the corresponding nozzle. It is customary in modern plants to have a number of units operated in synchronism feeding into a single set of bus-bars. In order to equalize the distribution of the load between the different units, it is advised that a single governor driven by a small synchronous motor be used. The governor piston shifts a long vertical lever on a rock-shaft which has arms acting on floating levers, one for each wheel. These levers are also actuated by connections from the nozzles and they in turn operate the pilot valves which admit pressure fluid to one side or the other of the operating cylinders located under each nozzle. This same apparatus can be employed for stream deflectors, instead of shifting nozzles.

It is acknowledged that the use of the

needle and deflecting nozzle is not a perfect means of governing turbine plants, and it is still necessary to employ safety valves. Drawings are presented of a double-beat safety valve for the main pipe line. This valve, instead of being held closed by a spring, is retained in position by means of a piston subject to fluid pressure. When necessary to relieve the water-hammer, the pressure in the controlling cylinder must first be reduced, and then slowly restored. This is accomplished by a connection from a rotating pilot valve. A great increase of the water pressure in the main line connection to the pilot valve causes this valve to shift its position and cut off the pressure from the controlling cylinder of the safety valve, allowing the latter to open and discharge the surplus water. The operation of this device when it is needed is insured by the continual rotation of the piston in the pilot valve, so that it is certain that it does not stick. The reliability of a valve of this type is considered to justify its increased cost over the ordinary spring-actuated safety valves.

Speed Regulation of Water-Power Plants.

By John Sturgess, Troy, N. Y.

This paper contains very little in the way of details of governor construction, but treats almost entirely of the characteristics of governor action. In considering the regulation of a water-wheel the question is not only of the governor alone, but it is necessary to consider the whole plant, which is composed of the following principal elements: First, a great body of moving water; second, a turbine wheel so set that all the water passing through the pipes or tunnels must pass through the wheel; third, a gate, usually set immediately before the wheel, for controlling its power output; and fourth, the governor which automatically operates the gate so as to maintain a uniform speed on the wheel shaft. The effect of the opening and closing of the gate is discussed, this question not being so simple as might appear at first to a tyro. For instance should the load of the wheel be reduced and the speed increase, and therefore cause the governor to reduce the aperture, the immediate effect may be, instead of reducing the power of the wheel, to actually increase it at the very moment when uniformity of speed demands that it be decreased, this being a consequence of the inertia of the moving body of water, which causes the same amount of water to be ejected on the wheel, but with an increased velocity due to the contracted area of the aperture. The use of relief valves or stand pipes is discussed, and attention is called to the fact that a relief valves only takes care of one-half of the difficulty, for while it will check in a large measure the *increased* pressure due to closing the gate, yet it is powerless to avoid the *decreased* pressure due to an opening movement of the gate. A stand pipe is more effective in this direction. The best forms of relief valves are mechanically operated by the movement of the gate, instead of depending upon the increase of pressure to set them in action.

The views of Mr. Sturgess on the best form of governor appear to be just the opposite to those of Mr. Replogle, inasmuch as he states, "the most successful governors are of the hydraulic class," and consist of a centrifugal governor, which operates a small piston valve which in turn controls hydraulically a larger valve and this in turn controls the piston in a hydraulic cylinder which operates the gate of the water-wheel. The governor also contains what he calls a compensator, by which the movement of the governor piston reacts on the centrifugal governor or its connections, so as to virtually reverse the movement which was initially produced by the changed speed, and to allow thereby for the change in the amount of water discharged, and thus avoid hunting.

In the provision of governors, the practice in America and Europe is quite different. In the former country the manufactures have specialized, and the construction of water wheels and of governors has been carried on as separate businesses; while in Europe the governor is specially adapted to the particular type of water wheel upon which it is to be used, since it is not made according to a stock design of a governor manufacturer.

In order to secure good regulation it is necessary, first, that the smallest departure of the speed from normal shall cause the hydraulic piston to operate, and secondly, that it shall operate with extreme quickness. The author cites a case in which he made tests on an 1100-h.p. unit, and found that on throwing off the full load, the five gates were completely closed in 1 2/5 seconds, a very creditable performance. The action of a governor at a change in load is analyzed with the assistance of a diagram plotting the same quantities as were given in Mr. Replogle's first diagram. A very interesting set of curves obtained by the author in some tests on an 1100-kilowatt unit are given, a Schaffer & Budenberg tachometer having been used. The effect on the speed and on the governor and gate movements of changes of load, both decreases and increases, including the throwing on and the taking off of full load instantaneously, are very plainly shown. When the whole load was thrown off, the speed accelerated about 8 per cent. in less than a second's time; but the governor had the gate shut in 1.4 seconds after the load went off, and there was then a little oscillation before it settled down to a new opening, the speed meanwhile varying very little indeed. Cards are shown from Bristol's recording voltmeter showing the comparative e.m.f. regulation of generators driven by a Ball & Wood automatic engine and by a water wheel, the results being very similar.

Mr. Sturgess' requirements for good regulation are as follows:

First, the governor shall apply to the gates a definite amount of energy.

Second, it shall operate on the speed varying ½ per cent. from normal.

Third, on a considerable change of load taking place it shall promptly move the gates to the position required by the change of load.

Fourth, it shall move the gates through their full range in 1½ seconds.

Fifth, under steady head and steady load it shall remain stationary, and it shall not make more than three movements in readjusting the gate after any change of load.

Photographic views are given of a few governor installations.

Efficiency Tests of Turbine Water Wheels.

By Wm. O. Webber, Boston, Mass.

These are records of a series of consecutive tests under uniform conditions of four water-wheels, with the same apparatus and the same observers, to determine the efficiency of the wheels, and to ascertain the effects of corrosion and wear upon the relative efficiency, also to determine whether more modern wheels would show greater relative efficiencies, and whether it would be more economical to operate all the wheels at part gate all of the time, or some of the wheels at full gate part of the time. The tests are instructive because of the wide range of speeds and gate openings covered systematically and consecutively. They show conclusively that water-wheels should be run at the speed for which they are designed under any given head, that modern wheels, with coarser buckets, having a spoon-shaped discharge depending below the guide ring of the wheel, and with the outer periphery of the bucket at discharge of greater diameter than the bucket at entrance, would give much more power, higher speed, and greater efficiencies from the same water than could be obtained from wheels of older design without these modern improvements. They also show how rapidly a complete series of efficiency tests of a wheel can be made with properly designed apparatus, efficiently handled by a corps of intelligent observers.

Two of the wheels were vertical Risdon wheels, 54 inches in diameter, made by the Holyoke Machine Company about 30 years ago, and designated respectively as the North and South Risdon wheels. Each wheel gave 221 horse-power at 128 revolutions per minute under 24 feet head. They were used to drive Worthington power pumps. The third wheel was a 40-inch Risdon wheel, giving 215 horse-power at 173 revolutions per minute. This

(*Continued on page 624*)

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Contents.

	PAGE
Stay-Bolt Threading and Turning Machine	601
What is Going On in Some of the Shops of the Middle West—I	602
Legal Notes	605
Engineering Reminiscences	606
An Analysis of the Cutting-off Machine	611
Letters to the Editor: The Liability of the Machinist .... Photographing Blue-prints....Interchangeable Boring-Bar Cutters....The Value of Technical Education .... Decimal Equivalent of Ounces....Badly Designed Tools....Making Interchangeable Crossheads....Reply to Apprentice....Apprenticeship and Industrial Education....The Inexact Science of Engineering....An Ink Bottle Holder	612-616
Convention of the National Machine Tool Builders' Association at Atlantic City	617
Discussion on Industrial and Technical Education	617
David O. Paige	618
The Chattanooga Meeting of the American Society of Mechanical Engineers	619
Chattanooga as a Manufacturing Center	624
The American Institute of Electrical Engineers on the Metric System	626
The Millihour Watch	626
New Tools and Machine-Shop Appliances	627
The Change of a Grinder from the Inch to the Metric System	627
The Addition of Binary Fractions	628
Some English Shop Notes	629
Echoes From the Oil Country—The Machinist's Lecture on Mechanics	630
Obituary	632

Chattanooga as a Manufacturing Location.

A prominent member of the American Society of Mechanical Engineers residing in Chattanooga, and himself a successful manufacturer there, in conversation inquired how or by what means members of the society might become interested in Chattanooga as a location for new manufacturing enterprises, especially those which used considerable quantities of pig iron.

He said that Chattanooga and vicinity needed an establishment for the manufacture of Corliss engines. There is a great deal of work to be done in connection with cane mills, and for other purposes, to which the Corliss engine is, he believes, peculiarly well adapted, and for which class of service it will always—or for a long time—remain the favorite prime mover.

The cost of pig iron he believed was of considerable importance in the manufacture of Corliss engines; and in Chattanooga the manufacturer finds a great advantage with respect to supplies of that important material; the price in this section being the Birmingham price straight, or with a very small advance; whereas, the price of pig iron elsewhere in this country is the Birmingham price plus the freight—amounting in Milwaukee to $3 per ton or over.

The advantage of situation with respect to pig-iron supplies has already led to a very considerable development of the foundry business in Chattanooga; but it is felt that a further development is needed of the industries which are concerned with the finishing of castings made from this cheap pig iron. The cotton mills of the South are also demanding considerable machinery not hitherto called for. An establishment for manufacturing pulleys, hangers and other transmission devices, it is believed, would do well; and there are a number of other industries calling for the employment of machinists, which there is every reason to believe would do well in this favorably situated region.

As to the capital required for the establishment of such enterprises, that would not usually be supplied by local capitalists—most, if not all, of whom have every dollar occupied in industries and enterprises which are satisfactorily productive. But for those who can otherwise command capital, and who have had the necessary experience in the line of manufacturing in which they propose to engage, it is believed that Chattanooga offers exceptional opportunities.

As to the workmen, it is pointed out that the conditions of life in this region are relatively easy. Houses do not need to be as expensive; they do not need to have the cold-resisting qualities that houses located in the northern country must have; nor is as much fuel required to keep comfortable during the short winter months. This applies also to the shop buildings themselves, which do not cost as much for construction, nor as much for heating, as they do in the northern States. It is a land of plenty; foods of all kinds grow in abundance; and it is relatively easy for men to acquire homes and to live in this region in comfortable circumstances.

In the matter of health, also, Chattanooga has great advantages; pulmonary difficulties being almost, if not entirely, absent from this region; and the country being otherwise favorable for the establishment and maintenance of good physical conditions. While it is warm at times, during the summer the nights are, in this elevated mountain region, cool and comfortable; much more so, in fact, than in many places further north in which manufacturing operations are carried on.

There can be little doubt that this section of the country will develop with great rapidity in a manufacturing way within the next few decades; and it seems likely that those who are earliest upon the ground will reap the more abundant harvest.

The Chattanooga Meeting of the A. S. M. E.

(*Continued from page 623*)

wheel was designated as the "Electric Light Wheel," and was about 10 or 12 years old. The fourth wheel was a 39-inch Hercules wheel, driving a Deane geared pump. This wheel was more modern than the others, and its horse-power was 276 at 146 revolutions per minute, the same head as before.

The Prony brake employed is described in detail, some drawings of it also being presented. The pulley was 48 inches in diameter by 26¼ inches face, and the weighing was done by a combination of two levers, forming a compound lever.

The tests are described in detail, and diagrams are presented giving efficiency, power and water curves, and there is also a table for each of the wheels, giving the figures in detail for each one of the tests made on that wheel. The highest efficiency in the tests of the North Risdon wheel appear from the diagram to have been 76 per cent. with a full gate opening. For the South Risdon wheel, with the same proportion of opening, the highest efficiency is about 69 per cent. The Electric Light wheel shows a maximum of about 72 per cent, at a gate opening which is stated as 1 per cent., but evidently means 100 per cent. The Hercules wheel can boast of an efficiency running as high as 89 per cent.

TURBINE DESIGN AS MODIFIED FOR CLOSE REGULATION.

By George A. Buvinger, Dayton, O.

The first detail of turbine design considered by the author is the subject of gates, of which the most important types used with the inward flow reaction tur-

time are the cylinder gate and the swivel or wicket gate.

In the former type an iron ring is fitted on the inside of the chute case, and this ring moves parallel to the axis of the shaft, and has at given intervals around its periphery, extending across the water passages, gates which are in form sections of a cylinder, and which are parallel to the axis. The movement of the ring carries all the gates with it, therefore giving an equal amount of opening to all the chutes. Gates of this type are subject to little wear, remain tight after long usage, and are practically balanced when used on a horizontal wheel. They have, however, the defect, that at part opening, the efficiency is low, though it may be improved somewhat by forming the gate with a lip.

The swivel gate, which can be constructed so as to be well balanced, has a very good efficiency when partly open, since there are no eddies formed as in the case of cylinder gates. In form these gates resemble a series of butterfly valves, the trunnions of which extend outside of the wheel case and have mounted upon them rocker arms, by which the gates are all connected to one another and operated from the governor.

Another type of gate is employed with the Girard type of impulse wheel used for water powers having heads from 100 to 1000 feet, where the quantity of water is small. In this arrangement the chutes are divided into three groups, arranged around the circumference of a circle, and inside of this circle are the three gates, the operation of which, taken collectively, is analogous to that of a plug-cock, except for the numerous openings. The gates are so arranged that their action on each of the three divisions is not simultaneous, thus, supposing the gates to be entirely closed, the first movement will partly uncover one chute in one section, a further movement will increase this opening and partly uncover the first chute in another section, and so on. By this means a very good efficiency curve is obtained. Drawings of all these types of gates are presented.

Attention is called to the necessity for careful consideration in the design of the connections between the governor and the gates; if these points are correctly designed, the governor will be able to keep the variation within 2½ per cent. under charges amounting to half the load when the power-house conditions are favorable.

The necessity for correct proportioning of the draft tubes is spoken of, it being stated that the area of the draft tube should be such that, at full gate, the draft head is approximately equal to the distance of the shaft above tail water, less the resistance in the pipe and the velocity head of the water leaving the draft tube. Mr. Buvinger also discusses the question of the water inertia and the "breathing" of the feeder pipe. Fly-wheels, of course, give some improvement in the conditions, but they are not very much used because their effect is comparatively small. The use of a stand-pipe on the feeder is very favorably spoken of, having been used successfully under heads as high as 250 feet. The stand-pipe should be as near the power-house as practicable, and should be of sufficient size to supply water to the plant during the time necessary for the column of water in the feeder pipe to change from one velocity to the other under changes of load as high as 50 per cent. at least. A by-pass which opens as the gates of the turbine close is also of advantage in cases where the water is used for irrigation; otherwise it is wasteful of water. Relief valves can be used in this latter case; they are only useful, however, to keep the pressure from becoming too great, but do nothing to accelerate the water, when the gates increase their opening. They should be tested once a day, in order to be sure that they will be in working order, when needed. An account is given of the difficulties met with, in an 800-h.p. installation in Jamaica, and the efforts made to overcome them, which were finally successful after the construction of a stand-pipe and reservoir.

The paper does not contain any discussion of the detail construction of the different types of governors. Mr. Buvinger states that with a correct understanding between the engineer, the turbine builder and the governor manufacturer, the most severe conditions can be met in such a manner as to obtain the closest regulation demanded in any plant.

The session was then concluded by the passage of the usual resolutions of thanks; these resolutions including the Chattanooga Railways Company, the Nashville, Chattanooga & St. Louis Railway Company, and the local committee.

Before the resolutions were put, Jesse M. Smith called attention to the manner in which the local committee had been assisted by the representatives of the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the various Government engineers connected with the improvement of the Tennessee river, and referred to it as a very happy illustration of the manner in which engineers of all classes are being drawn together—a remark which was received with a round of applause.

THURSDAY AFTERNOON EXCURSION.

Thursday afternoon was occupied by another absorbingly interesting excursion to the battlefields of Chickamauga and Missionary Ridge, the former of which witnessed losses of 35,000 men on both sides and is now a Government park, while both are studded with monuments and tablets commemorating the great events there enacted. On this occasion as on that of the excursion to Lookout Mountain, the party was accompanied by Hon. H. Clay Evans, late consul general to London and an officer of the Union forces during the war, and by Capt. H. S. Chamberlain, post quartermaster U. S. A. at Knoxville during the war. Both gentlemen are thoroughly familiar with the great campaign of this section and by formal addresses and, perhaps still more by a constant running conversation, informed the excursionists of the significance of the numerous monuments, of the objects of the campaign and of the leading events of the battles.

Nothing could so well bring to the attention of visitors from the North, where the war has become more of a tradition than a memory, the vitality of the memory of the struggle among the people of the South.

Chickamauga Park is now also an army post, and the visitors were further entertained by a full regimental cavalry drill.

FRIDAY'S EXCURSION.

During the morning of Friday, the visitors made such use of their time as suited individual convenience and preference; the only organized excursion being one that had been arranged by Chas. W. Melcher, of the Ingersoll-Rand Company, through the courtesy of H. H. Thrasher & Co., contractors for a double-track tunnel now being driven by the Southern Railway through Lookout Mountain. Carriages took the guests from the hotel, for a very pleasant drive, over a portion of the mountain to the headings, where a good opportunity was afforded for witnessing the operation of compressed-air machinery employed in work of this character.

Early in the afternoon the party boarded a river steamer, and ran down the river to Hale's Bar, which is the site of the work described and illustrated in Mr. Murray's paper, previously presented during the meeting.

Aside from the surpassing beauty of the mountain country through which the Tennessee winds, the trip was of very great interest from the engineering standpoint, and made more so by the presence of a number of engineers directly connected with the work, familiar with every feature of it, and with an apparently inexhaustible stock of patience for the answering of questions pertaining to it. Major Newcomer and Mr. Guild particularly, were kept busy in explaining features of the work; and, finally, in response to demands, mounted upon a scraper and gave short addresses explaining the location of the dam, the methods by which it is being constructed, and the features to be possessed by the power-house. Mr. Guild mentioned the fact that the American Society of Mechanical Engineers had in a way been an important factor in the inauguration of the work. Considerable investigation of

the possibilities of doing it had been made, with the result that it had been practically given up, until Newell Sanders, during his attendance at a meeting of the society, went to see a power development on something of the same lines as is here being worked out. Mr. Sanders returned to Chattanooga with renewed enthusiasm regarding the possibilities of the work and inspired others with his enthusiasm, with the result that the work was inaugurated, and is expected to be completed in about one year from next October.

President Taylor referred to the importance of the cost of power in determining the location of manufacturing enterprises, advised that control of this enterprise be carefully and strictly maintained by local capitalists interested in the development and welfare of Chattanooga, and that power be sold in small, rather than in large units; experience having shown that, where power developed in this manner has been sold in large units, it has resulted in the establishment of a few large enterprises, rather than a larger number of smaller ones, and with less advantage to the city.

Secretary Hutton, in response to a call, made appropriate and graceful remarks, expressing the appreciation of the members of the society and their admiration of the many things seen during the visit, and finally Mr. Sanders, the quiet, cool, efficient master of ceremonies and chairman of the local committee, closed the last formal act of the convention by expressing the pleasure the local engineers and citizens of Chattanooga had experienced with their visitors, and the hope that many of them would return and stay; Chattanooga being in need of such men to develop its industries.

Re-embarking, the trip down the river was continued to a point where a railway train was in waiting to convey the party back to the city, where they arrived at about seven o'clock, and alighted from the train alongside of the old locomotive "General," which, carefully preserved, stands within the Union Station opposite the hotel, as a monument to the memory of the Andrews Raiders, who, in 1863, captured this locomotive and started south with it, with the intention of burning the bridges along the railroad, and thus cutting off the line of communication between the Confederate Army and its Southern base of supplies.

Thus closed what is generally considered to be one of the pleasantest, if not the most enjoyable convention of the society. The members made up in enthusiasm what they lacked in numbers: the total registration being only about 200. But the members who did not attend will probably long hear of the very great pleasures enjoyed in this delightful, hospitable and historically interesting city.

The American Institute of Electrical Engineers on the Metric System.

Under date of April 5 the following was sent to members and associates of the American Institute of Electrical Engineers:

"The following preamble and resolutions concerning the 'Metric System' were favorably reported to the Board of Directors by the Standardization Committee at the directors' meeting of March 23, 1906. In view of the importance of the questions involved and the possibly differing views of the membership at large, the board decided to submit the matter to the membership for a letter ballot. It is proposed to transmit the result of this ballot to the Congressional Committee on Coinage, Weights and Measures before May 1:

Whereas, The Metric System of weights and measures offers very great advantages by its simplicity, consistency and convenience in every-day use, as well as in engineering and scientific calculations and computations; and

Whereas, These advantages have already been demonstrated by the universal adoption and entirely successful use of the Metric System in all civilized countries, except Great Britain and the United States; and

Whereas, All the electrical units in universal use, such as the volt, ampere, ohm, watt, etc., are metric units; and

Whereas, The industrial use of these electrical units would be much facilitated by the general adoption of the metric system:

Resolved, That this committtee unanimously recommends the introduction of the metric system into general use in the United States at as early a date as possible without undue hardship to the industrial interests involved.

Resolved, That this committtee favors such legislation by Congress as shall secure the adoption of the metric system by each department of the National Government as speedily as may be consistent with the public welfare.

F. B. Crocker, Chairman.

February 27, 1906.

"Kindly tear off and return at once one of the ballots printed below."

A communication from the secretary, dated May 5, says:

In order to ascertain the attitude of the membership of the A. I. E. E., the report of the Standardization Committee in the form of the enclosed resolution was submitted for letter ballot to the associates and members residing in the United States, numbering about 3300. The returns up to May 5 were as follows:

In favor of the resolutions.....	1569
Against the resolutions	178
Total vote	1747

This vote is not to be considered as the official action of the Institute, but simply to test the views of the members who were sufficiently interested in the matter to cast a vote.

The Millihour Watch.

The *Electrical World* published an illustration of a new thing in stop-watches called the Millihour stop-watch, which it refers to and describes as follows:

"A stop-watch designed for electrical meter-testing work, which has proved to be a successful tool in the hands of the meterman, as it enables him to do away with many calculations and permits the use of testing methods of simplicity hitherto unknown. The watch is non-magnetic and has a running time of 0.01 of an hour for the complete revolution of the large hand. The dial is divided into ten divisions representing 0.001 of an hour, or one millihour.

The object of this appliance is to get readings direct in decimal parts of an hour, since the watt-hour is the standard for the measurement of electrical energy.

If a watt-hour meter shows a certain number of watt-hours (revolutions X watt-hour disk constant) in a certain number of millihours, the quotient of both will give the load in kilowatts passing through the meter.

If a given load in watts is applied to the meter for a time of 10 millihours (100 divisions on the watch) it can be arranged so as to compel the disk of a correct meter to complete one, two, three, etc., revolutions in this space of time. The same meter, if out of adjustment, for instance, slow, will, under the same load, make the same number of revolutions in a longer time, and the watch will show direct without calculation, in hundreths, the correction factor of the incorrect meter, thus saving time and cutting out all liability to error. This watch, it is said, has found acceptance by a number of California electric companies, and is sold by Mr. Kleinenbroich, Oakland, Cal., and has been brought to our attention by J. Van der Zande, of the United Railroads of San Francisco."

This seems to be analogous to Wilfred Lewis' decimally arranged time-keeping clock, which we described some time ago, and by means of which intervals of time between starting on and finishing jobs are indicated in decimal parts of an hour.

It will interest the acquaintances of Henry Dreses to learn that the Dreses Machine Tool Company, whose shops at Cincinnati were recently destroyed by fire, has already gotten most of its new machinery installed in the new quarters on McMicken avenue, where about 75 workmen are employed at present, and it is expected that the entire plant will be in operation in a couple of months. The new quarters give the concern 25,000 square feet of floor space as against 17,000 in the works that burned.

New Tools and Machine Shop Appliances.

A MOTOR-DRIVEN SPEED LATHE.

A motor-driven speed or spinning lathe has recently been brought out. The headstock is fitted with a 1-h.p. motor direct-connected to the spindle.

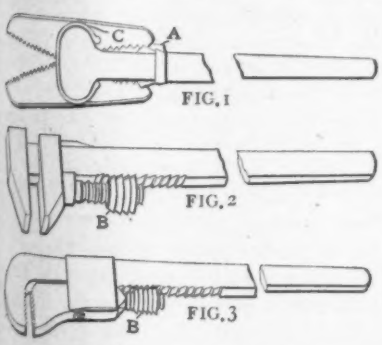
The motor is equipped with a Cutler-Hammer controller with a range of speeds from 800 to 2,000 revolutions per minute. The tool rest and tailstock are secured by cam binders. At the back of the lathe there is a wooden shelf supported on iron brackets.

These lathes are made 10, 12 and 15 inches swing, with screw, lever, or combination tailstocks. They are manufactured by the Garvin Machine Company, New York.

SOME HANDY WRENCHES.

The illustration shows a new line of adjustable alligator, monkey and pipe wrenches. The adjustable block *A* is inserted between the rear ends of the jaws to set the front ends closer together. The serrations on the rear ends of the jaws and the tension of the spring *C* prevents it from shifting. Fig. 2 is the monkey wrench. The handle is provided with a series of ratchet grooves into which the grooved nut *B* fits. The nut *B* is instantly movable to any position along the ratchet face of the handles, while the screw gives the finer adjustment.

Fig. 3 shows the pipe wrench. The adjustment of the jaw is practically the same as that of the monkey wrench; in both of



SOME HANDY WRENCHES.

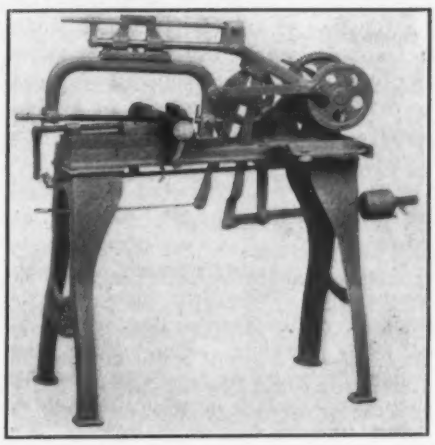
these tools the nut is primarily seated by the aid of a spring, in action the forces also tend to seat it. These wrenches are made by the Monarch Tool Works, St. Louis, Mo.

FORGES USING COMPRESSED AIR.

The Buffalo Forge Company, of Buffalo, N. Y., has recently put on the market an arrangement for supplying air for rivet forges from a main compressed air system. The air is in one case introduced into a mixer nozzle by a small needle valve so arranged that the high-pressure air draws a quantity of free air along with it. In the other, the small jet of air impinges against the blades of the forge fan, turning it and drawing in free air in this manner for mixing purposes.

A POWER HACKSAW.

The accompanying illustration shows a hacksaw machine driven by cut gearing, and provided with a swivel vise which can be adjusted to cut off material at any angle up to 45 degrees. This adapts it for use in structural iron-shops. The



A POWER HACKSAW.

feed is by gravity and when the metal is severed, the saw stops automatically.

The machine is built by the Diamond Saw and Stamping Works, Buffalo, N. Y.

The Change of a Grinder from the Inch to the Metric System.

Many machine tool builders have encountered the problem of how to adapt their machines to the doing of metric work when such tools are ordered for use by foreign customers. An interesting and instructive example in this line is afforded by the method of the Norton Grinding Company, of Worcester, Mass., and we illustrate the mechanism showing their method. This is the cross-feed mechanism of a Norton grinding machine, with which machine it is very important to be able to move the grinding wheel to or from the work by very small and very precise amounts. When the machine is to be used here or in England these movements must be in terms of the inch; when the machine goes to the Continent of Europe, as many of them do, the movements must be in terms of the millimeter, and, as arranged, the change is made from one to the other with the greatest ease and simplicity.

Referring to the photograph the pitch of the cross-feed screw and the proportion of the gears actuating it are such that, for inch dimensions, the index pin *A*, when moved from one hole to the next, moves the wheel slide 0.000125 inch and therefore causes a reduction of the work diameter of 0.00025 inch or, in shop language, "a quarter thousandth".

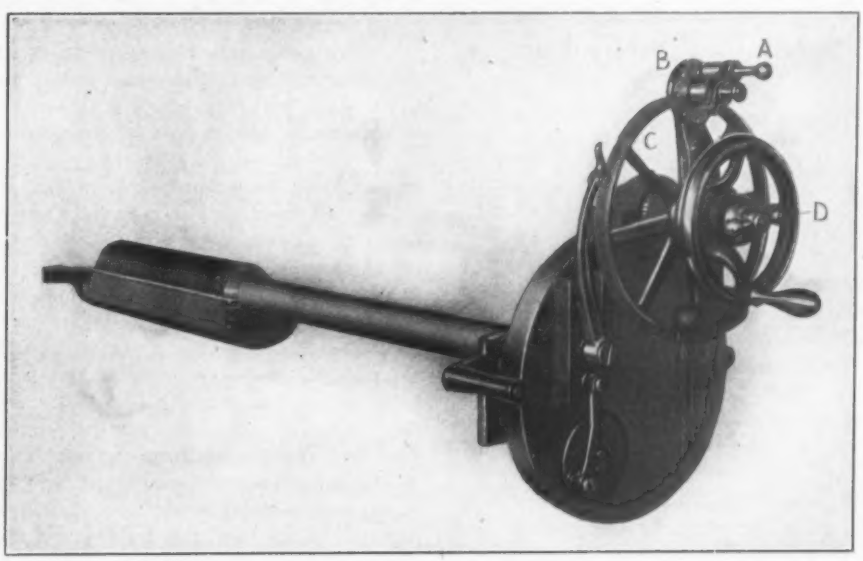
In this case the index plate *B* has 8 holes and the small pinion, which does not show in the photograph, but which engages with the wheel *C*, has 8 teeth.

When a machine is to go to a metric country and supposing it to be rigged up as described and shown, the binder *D* is removed by unscrewing it and another wheel *C* and index *B* are slipped into place; the wheel being practically the same diameter but of different pitch, the index plate having 10 holes and the small pinion referred to having 10 teeth instead of 8.

The effect of this is that the movement of the index pin from one hole to the next is to move the cross slide 0.005 mm. and consequently cause a reduction of the diameter of the work of 0.01 mm.

The change from one outfit to the other is of course made within a minute or two and the difference in cost between one mechanism and the other is inappreciable, if there is any difference.

Our readers are of course familiar with the fact that when traversing screws are used that are depended upon for moving slides through considerable distances the



THE CHANGE OF A GRINDER.

screws must be made metric or, "translating gears" must be used. In the case of this grinder, however, that is not necessary because the grinding wheel is never moved from one position to another by means of the cross-feed screw in sizing work except for small distances i.e., distances which represent the reduction of diameter by grinding. On this account the error caused by the method described is negligible. In an inch of movement of the slide it would amount to 0.0039 inch, but in using the machine for grinding off say 0.01 mm. the micrometer shows no error and this can be done 20 or 30 times successively, depending entirely upon the index without showing an error, so that within the limits of use there is, practically speaking, no error. For a tenth of an inch movement the error would be 0.00039 inch and for a hundredth of an inch 0.000039 inch. The parts composing the cross-feed mechanism are separately manufactured and kept in stock in the Norton shop so that when an order is to be filled from stock it makes no difference whether the order comes from a metric or an inch country, for by simply running off the binder *D* and putting on the proper wheel and index plate the machine is transposed from one system to the other so far as its ability to do work is concerned and that is all that very much concerns the user.

In the later construction the hand wheel is dispensed with and the crank handle placed directly in the end of the index lever diametrically opposite the index-pin mechanism, but of course that makes no difference, so far as changing from one system of measurement to the other is concerned.

The Addition of Binary Fractions.

BY F. A. HALSEY.

Nothing surprises me more when going into drafting rooms than to find draftsmen laboriously adding dimensions given in binary fractions by the use of their thumb nails on a drafting scale or, in some cases, by reducing to a common denominator after the regulation method with vulgar fractions in general.

Binary fractions form a class by themselves and have little in common with vulgar fractions in general, except the form in which they are written. The school arithmetics do not recognize this difference, nor, indeed, do they even recognize the name by which these fractions are known, and the result is that each individual is left to discover their properties himself and this, apparently, few do.

As a matter of fact, except in the manner in which they are written, binary fractions are much more closely related to decimal than to vulgar fractions. The essential principle of decimals is that each denomination bears a fixed ratio to those preceding and following it and this is precisely the principle of binary fractions. In the case of decimals the ratio is 10, while in the case of binary fractions the ratio is 2. Just as 1/100 is one-tenth of 1/10 and 1/1000 of 1/100, so ⅛ is one-half of ¼ and 1/16 of ⅛. This identity of principle is obscured by the fact that the decimal system of notation leads to different methods of expressing these quantities. Were our system of notation based—as it is the pity of pities it is not—on 8 instead of 10, binary fractions would be expressed as decimals are now, showing that the difference between our usual methods of writing them is not in their nature, but is an outgrowth of our system of notation.

Even written as they are, the addition of these fractions usually requires less effort and is just as simple, mentally, as the addition of decimals and, as might be expected from their similarity, the addition of the two classes is exactly alike in principle, except that, when adding decimals, we divide by ten after each partial addition, while, in adding binary fractions, we divide by two. The quotient after each division is carried to the next partial addition and the remainder is set down as a part of the answer, in exactly the same way in both cases, the difference being that with binary fractions half the time we have no remainder, and when we do have one it is always 1, whereas with decimals we have a remainder 9 times in 10 and it may be anything betwen 1 and 9 inclusive.

The binary fractions possess a positive advantage when adding them horizontally, as they commonly appear on a drawing, as there is no difficulty in picking out the right figures, the denominators forming a positive guide and making mistakes in this respect almost impossible, and there is hence no necessity for those who shy at horizontal addition writing the quantities in a column which many do for safety when adding decimals.

Like all arithmetical processes, this seems far more laborious and involved in the explanation than in the fact. With a small amount of practice it becomes instinctive as with ordinary addition. We do not realize how many mental efforts we make in ordinary addition and perhaps there is no better way to illustrate the simplicity of the method to be described than to perform the operation on the same quantities expressed both in binary and in decimal fractions. For this purpose let us take the following illustration, which is certainly as serious a one as the draftsman often has to deal with:

$$4\tfrac{3}{8}+3\tfrac{1}{2}+4\tfrac{7}{16}+\tfrac{1}{32}+2\tfrac{5}{32}+1\tfrac{7}{16}+\tfrac{9}{32}+2\tfrac{1}{4}=?$$

In order to point out the identity of the mental processes when adding binary and decimal fractions let us first perform in detail the addition of these quantities expressed as decimals, omitting, however, all figures beyond the third decimal place in order not to be pedantic and also to avoid an unduly labored explanation.

Expressed in decimals the problem becomes:

$$4.375+3.25+4.437+0.094+2.156+1.562+0.281+2.75=?$$

Adding the thousandths we have:

$$5+7+4+6+2+1=\tfrac{25}{1000}=\tfrac{2}{100}+\tfrac{5}{1000}$$

the 5 forming part of the answer and the 2 being carried to the hundredths thus:

$$2+7+5+3+9+5+6+8+5=\tfrac{50}{100}=\tfrac{5}{10}+\tfrac{0}{100}$$

the 0 forming part of the answer and the 5 being carried to the tenths column thus:

$$5+3+2+4+1+5+2+7=\tfrac{29}{10}=2+\tfrac{9}{10}$$

Proceeding as before with the whole numbers we have:

$$2+4+3+4+2+1+2=18$$

and, annexing the several remainders to the final 18, we have for the answer,

$$18+\tfrac{9}{10}+\tfrac{0}{100}+\tfrac{5}{1000}=18.905$$

Taking up now the binary fractions, we proceed in exactly the same way, beginning with those having the largest denominator—32. Adding these we obtain:

$$3+5+9=\tfrac{17}{32}=\tfrac{1}{16}+\tfrac{1}{32}$$

the $\frac{1}{32}$ forming part of the answer and the $\frac{1}{16}$ being carried to the sixteenths, which are next added, thus:

$$8+7+9=\tfrac{24}{16}=\tfrac{1}{8}+\tfrac{0}{16}$$

the $\frac{0}{16}$ forming part of the answer and the $\frac{1}{8}$ being carried to the eighths, which are then added, thus:

$$12+3=\tfrac{15}{8}=\tfrac{7}{4}+\tfrac{1}{8}$$

the ⅛ forming again part of the answer and the 7/4 being again carried to the fourths thus:

$$7+1+3=\tfrac{11}{4}=2+\tfrac{3}{4}$$

Proceeding as before with the whole numbers we have

$$2+4+3+4+2+1+2=18$$

and, annexing the several remainders to the final 18, we have the answer

$$18+\tfrac{3}{4}+\tfrac{1}{8}+\tfrac{0}{16}+\tfrac{1}{32}=18\tfrac{23}{32}\text{ or }18\tfrac{7}{8}+\tfrac{1}{32}$$

as I prefer to express it on the drawing.

A glance back over the process will give us a new respect for the simplicity of binary fractions for, counting up the partial additions that have been made in summing both kinds of fractions, we find a total of 7 in the case of the binary and 20 in the case of the decimals. What the average ratio is would not be easy to determine, but it will usually be found in favor of the binary factions and heavily so when, as in this case, the decimals are the equivalents of binary sizes.

The draftsman who will become familiar with this method by a little practice will never go back to the thumb-nail-and-drafting-scale plan again.

Magnesium is an excellent deoxydizer for Britannia and tin casting alloys. If used in the form of magnesium-tin it will be satisfactory.

Some English Shop Notes.

BY JAMES VOSE.

Opportunity presenting itself, advantage of it was recently taken to spend a few days in the Birmingham district and visit old and new friends in that vicinity.

At Kidderminster some idea of the processes and machinery employed in carpet manufacture was obtained. At first sight the looms are extremely complicated, but on further inspection resolve themselves into the essential weaving device for making the strong textile backing, plus arrangements for inserting in loop form, the material forming the pile of the fabric, locking it in place, and cutting the pile. The Jacquard apparatus is employed on these looms in a manner varying considerably from that usual when dealing with cotton or woolen manufactures. On one class of carpet the pattern of the pile is made by the Jacquard machine causing bobbins or spools the width of the cloth—each spool being practically a small warp roll in which the differently colored threads are placed in proper parallelism—to be brought down from a chain of such spools in the order called for by the design, and it is most interesting to see how each difficulty in the way of embodying the necessary devices, in as compact a space as possible, has been met. In fact, I obtained the impression that a study of the devices for years regularly employed in textile machinery would form one of the best possible introductions to the subject of the design of "automatic" machine tools. The late Samuel Dixon, of Kendall & Gent's, Manchester, used to say the term "self-acting" was formerly considered good enough but "automatic" sounded much more dignified. The yielding character of the materials employed for the carpets mollify to a great extent the acerbities of the very intermittent mechanical movements found necessary in this class of machinery, but these characteristics have themselves to be controlled and kept within working limits, thus bringing up fresh problems for solution. I can quite understand the subject of weaving in all its branches having received considerable attention in all ages. Another style of carpet loom employs the Jacquard machine on much the usual lines, the warp threads being acted upon by the Jacquard and appropriate pile-cutting devices forming part of the loom equipment. In place of the longitudinal threads of yarn being wound on a barrel in warp form, as in ordinary weaving, each thread is drawn from a bobbin placed on a large creel or frame, considerable space being thus taken up. I noticed that dyeing is generally associated with carpet weaving but spinning is practically a separate industry. Owing to changes of fashion and decidedly stiff tariffs in foreign markets—particularly in the States—the carpet trade has been anything but uniformly good during the last few years, though, judging from Board of Trade returns, a distinct revival has recently been experienced. It is a curious fact that "obsolete" machinery is being purchased in Kidderminster for export to America.

Noticing on an unpretentious building a legend to the effect that Messrs. Turner manufactured wheels of all kinds without patterns or machines, I naturally investigated, finding the statement quite correct. Strickles and simple core boxes are employed. Three days are generally required in this system to turn out wheels. The first day the general shape of the wheel body is struck out in suitably strengthened green sand. The mold is light clay-washed and baked in the core oven during the night. On the second day the arms (formed by means of cores) are added and dried as before; on the third day, the teeth, which are formed by individually placing cores of the shape of the spaces between the teeth on the mold, are added, and the wheel cast. I was informed that an order just received on the Monday morning for a spur wheel 4 feet diameter by 6 inches face would be executed and the wheel at work on the following Thursday. The castings appeared in capital shape and quite equal to the general run of machine-molded wheels, and most kinds of gears wheels—spur, bevel, helical and worm—were to be seen. There is no pretense of employing modern equipment or buildings and no advertising is done, the concern simply relying on past good work for its trade which is obtained at prices as low as obtain generally, and so long as business retains its regular volume all appear content.

At Birmingham pleasant experiences awaited me. At Messrs. Thos. Chatwins' I personally tested a patented reamer of which the firm is making a specialty. It is of the straight-flute variety, the teeth being staggered somewhat, but in place of being tapered at the entering end it is stepped in two or three stages from say 1/64 inch under size—this amount varying with the size of the reamer—the teeth at each step cutting at their ends. I had no difficulty in reaming by hand several 31/32-inch holes to 1 inch diameter, the "feel" of the reamer during the operation being of a floating or velvety character. The holes produced were beautifully smooth. A reamer of the same size of ordinary design by a first-class maker and which had only 0.003 inch to remove, produced anything but satisfactory holes in the same material, chattering being much in evidence. Twist drills form a regular line in the firm's manufactures, and it was interesting to find the opinion expressed that high-speed drills had created their own market the sales of carbon-steel drills showing no diminution. A special line of twist drills is supplied for boiler-makers' use to withstand the severe duty expected in this class of work. One of Reinecker's double-spindle twist drill milling machines was being got to work in this department, and in the die department I noticed several of the Diamond Company's surface grinders which were highly thought of. British, American and Continental tools are employed quite indifferently, the only conditions governing their use being that they give the best satisfaction as profit earners. Messrs. Chatwin manufacture an extensive line of hand and machine tools for pipe fitters, bolt manufacturers, and engineers in general, and it was of interest to note how each class of tool was produced in all styles to suit different markets, from the solid, substantial, British patterns to the light, handy American types. In common with all the firms I visited, good business, both immediate and prospective, was reported.

Messrs. S. A. Daniels, Ltd., turn out an astonishing number of copying presses for a wide range of service. The Government pattern is extremely strong, wrought-iron cross-bars being specified. Several of the leading railway companies also have styles and patterns of their own. Notwithstanding the large number of other copying devices now in use, it is found that the sale of presses increases rather than otherwise. A specially strong line of carpenters' clamps is manufactured here, rolled steel sections being used and the rack or buttress teeth being produced in the rolls. Screw milling is utilized in the press and screw-jack department. A very good business is done in hand tools and machine-shop requisites in general. In the threading apparatus line a specialty of the firm is a screw-plate for gas pipe, which is arranged to thread several sizes of pipe, and also to carry a circular revolving cutter for cutting off the pipe. This device has been very well received by users. Before leaving the works Mr. Hadley drew attention to a very complete catalog of the firm's productions, printed in several foreign languages, the weights and dimensions being given metrically, but the prices given in terms of British money, the idea probably being that the relative values of British and Continental moneys were pretty universally understood.

In the pneumatic engineering line, Messrs. Alldays & Onions, Ltd., manufacture and handle everything from artistically decorated parlor hand bellows, to the largest motor-driven fans and pressure blowers. Everything connected with smith's shop requirements is also in order with them. Gas and oil furnaces for all grades of duty are also handled, all the details of air, gas, and oil admission having received adequate con-

sideration. One special application of oil furnaces is for the recovery of type metal. Some large Government contracts for forges and other smithy plant were going through, including somewhat unusually heavy straightening and bending blocks or floor plates. Some benches building to Government specifications for the use of erectors or bench hands in the naval dockyard shops, seemed to me phenomenally substantial and intended to last for ages. Taken in conjunction with other information more or less public it would appear that the various Government departments are renewing and adding to their equipment on a more consistent and methodical plan than for many years past. In the foundry, a kink I had not before seen, though it may be old to many readers, was in use. In the case of molds requiring the use of the crane when pouring, the pouring holes were dusted round with French chalk, thus assisting the crane operator in the period "between the lights" to place the ladles correctly. The manufacture of machine and hand vises, hand tools and threading appliances generally, regularly employs a good number of men, chain blocks and other lifting tackle also being dealt with in another department. The pattern and wood-working shop is supplied with modern equipment, the woodwork connected with the motor cars manufactured in the company's new adjoining automobile works being considerable, while to see the men constantly at work on the wood portion of all classes of hand bellows causes one to wonder what becomes of all the bellows produced. Like many other British works sections have been added to the buildings as called for, no regular plan having been carried out, but as opportunity occurs it is purposed to remodel the whole works.

A capitally laid out and equipped new plant is that of E. G. Wrigley & Co., Ltd. The work dealt with includes all classes of gear cutting, and the manufacture of milling cutters and twist drills. The roof is of the saw-tooth type, and the arrangements for carrying the main and counter shafts are such that great flexibility is obtained as regards ease of erection and change of location, no holes needing to be drilled in the iron work. The gear-cutting machines are without exception of the highest class, and considerable attention is being given to the equipment for producing high-speed twist-drills. The lavatory, cloak room and mess room accommodation is thoroughly up-to-date, no pains having been spared in the matter. A well furnished laboratory, from which headquarters the chemist supervises the testing, etc., of material and all hardening and tempering operations, adds its quota to the general efficiency. In the drafting room Universal drafting machines are freely used. For the reduction of steel gears, etc., of a repetitive nature for motor-car work, a number of Alfred Herbert's most recent turret lathes are utilized, and for analogous work in smaller quantities of a kind several Tangye Machine Tool Company's high-speed lathes of the latest design are installed. Space for considerable extension is available, and the works, which is typical of quite a number of plants erected in this country during the last few years, is calculated to dispel the quasi pessimism expressed by sundry British and other writers or prophets within recent years.

The Tangye Machine Tool Company, Ltd., next visited, has specialized to a considerable degree on high-speed lathes, etc. An upright drill (28 inch) was being tested previous to Government inspection, the machine being more than equal to any high-speed drill the spindle was capable of driving. The opinion was expressed by Mr. Pendlebury, the manager, that for maximum output, the hand lever feed was superior to the automatic feed, as the operator can work right up to the limits of drill and machine efficiency. Motor-driven lathes of all swings and capable of utilizing up to 60 horse-power each, were in progress and the experience of the company is that with motor drives even on lathes of medium swing, decided advantages in the way of increased production and general flexibility of shop layout are noticeable. On several lathes recently designed for truing up and re-profiling street railway car wheels extremely onerous duty has been performed, some of the cuts—on specially tough tire steel—specified by the customer's engineer being declared by several would-be tenderers for the contract, practically impossible of accomplishment. An interesting fact brought out in general conversation was, that in addition to repair ships in the navy, the Government is equipping field army corps with a mobile machine-shop service, the various machine tools being fixed on special wagons drawn by traction engines which, when halted, furnish the required power by driving dynamos and furnishing current to the motors embodied in the machine-tool design. When investigating high-speed or high-duty possibilities Mr. Pendlebury found that when taking light cuts at a circumferential velocity of 400 feet or more per minute, the finish obtained was very much superior to anything generally considered possible with the new steels. In addition to tools the firm builds most of the motors used in conjunction with them, their experience suggesting various modifications for special duties. A look through the large folios of photos of recently delivered tools emphasized the impression of progressiveness received during my tour round the works.

At H. W. Ward's Lionel Street works, among tools in progress were several substantially built rotary planers which by means of auxiliary spindles, were adapted for use as horizontal or vertical millers. All-gear lathes of various swings were also going through in addition to several styles of turret lathes and upright drills. Extension to the general working facilities were being carried out, and like many other firms here the concern thinks it best to have a fair variety in the classes and types of tools built, one tool often securing an order for another class of machine. Several other establishments had kindly given me permission to run through their work, but time did not allow, and I returned home all the fresher for my experiences, which at any rate demonstrated the reasonable accessibility of many shops.

Timperley, England.

Echoes from the Oil Country—The Machinist's Lecture on Mechanics.

John was a bright young man who did not believe in being so modest that the rest of the world would never know what good work the little shop was doing. He was the foreman of a shop doing repair work, and he had discovered that while the world at large was willing to believe in a general way in the excellencies of the work being done in the world of machinery, people were all too prone to think that the place doing the very good work was some place far off. He wanted them to think that his was the place and that he was the man, and once in a while, as the opportunity offered he would try to impress his visitors with the fineness of his product. You know that with a fellow who is doing all sorts of jobs these chances do not come every day, and so they have to be made the most of when they do come.

One day John was busy. He had several gentlemen in his place. They were waiting for a repair piece for an automobile, and the owner of the machine was in a sweat for fear that this shop could not do the work fine enough. While he did not profess to be anything of a mechanic he felt called upon to keep close watch on the man who did.

"This piece was a little tight. The bearing used to get warm. I want you to make the new one a little bit looser."

"Yes sir," said John. "I will make it any size you say. How much looser would you like to have it?"

The gentlemen did not really know, but he did not believe in seeming to be at a loss so he replied, "just make it a hair smaller than the other."

John thought he saw an opening for giving the visitors a few pointers.

"All right," said he, as he reached into his tool box and pulled out his micrometer, "If you will tell me which man's hair you wish me to go by I will do it."

The man laughed good naturedly at what he took to be John's little joke, and replied, "Suit yourself. If you are partic-

lar as to the color Mr. Kingson might even be induced to let you have one out of his whiskers." Kingson's whiskers were a bright red, and he blushed at having attention called to them.

"It doesn't make the least bit of difference to me which one I work with but if you want a good fit it will make all the difference in the world to you. Perhaps you think I am fooling about it but if you will wait a minute I will show you that I am not. I will take a hair from my own head. It measures two and a half thousandths. Here is the instrument that does the measuring, and I want you to take hold of it and see that it is all right. These little marks stand for thousandths of an inch. There are twenty-five of them around this piece and when I turn it around once it goes up to the next mark. I will run it up and show you that there are forty of the marks along there. Putting this measure up against it you see that it is just an inch from that mark at one end to this one at the other. As forty times twenty five make a thousand you see that moving from one of these marks to the next one means just a thousandth of an inch, and furthermore" (John thought that such a nice, big, ministerial sort of a word would surely impress them) "it is very easy to measure halves or quarters of a thousandth, and not be very far out of the way. A man who is used to doing reasonably fine work can even be very close to the ten thousandth."

While he was talking John was manipulating the micrometer. As his listeners were all educated men of standing in the community, they listened with interest. Even if they did not understand all of his statements they could follow his demonstrations.

John had them so interested that they soon gave him a number of hairs to measure. Two of them measured one and a quarter thousandths, the quarter being, of course, estimated, and one taken from the head of a plump young good natured fellow measured three and a half thousandths. He let them try to do the measuring themselves, and it was not long before they were arguing among themselves as to the exact measurements of the various hairs.

He got some paper and had them measure the differences between the different kinds, and had them note the fact that even with a good grade of paper it was easy to feel that it was not of a uniform thickness. Finally he broke in upon them. "Gentlemen, you have seen, or rather, you have felt enough to understand that I was not joking when I wanted to have the hair before I could give you a job that I could stand behind. If the owner of this job will pick out his hair I will finish the job."

"I guess we will have to admit that you can measure a hair but it is one thing to measure a thousandth of an inch and it is an entirely different thing to work that close. I have read about them doing such close work in watch factories. There they have all sorts of fine machines to work with, or at least I suppose they have, but you have nothing here but an ordinary lathe, and it is a good sized one." It was 27-inch swing.

John took up a couple of small pieces that lay on the bench. They were part of the job for the automobile, and were supposed to be the same size.

He tried his calipers on them and then asked one of the men to try the micrometer on them. The man declared that they were the same size. One of the other men tried and said that there was nearly a quarter of a thousandth difference, while still another disputed this. It was finally agreed that if there was a difference it was not more than that. They were very much surprised to find how much difference in the "feel" a thousandth of an inch made, and could hardly believe their eyes when John showed them how plainly they could see through a crack that was only a thousandth wide.

"Every man who is a mechanic knows all of these things that I have been showing you and a lot more. I am afraid that you would not believe me if I were to tell you how we have to make allowance for temperature and all of that sort of thing when we are doing anything that can be called fine work but we do have to, and there is another thing that we have to make allowance for, and I don't want any of you gentlemen to think that I am hitting at anyone here, for I am not, or at anyone in particular, for that matter," and John looked around to see that they were all interested and friendly before he went on, "but it doesn't make any difference how good a mechanic a man is, if he can't judge of the conditions his work has to do business under he will not be much of a success; not in work that goes into the hands of all sorts of people. You know for yourselves how people treat an automobile. Some men take good care of it, and use good oil and enough of it, and whenever they stop after a hard run feel the bearings, and if any of them get warm favor things a bit until everything is cool again. Some men rush through dust or mud, up hills and over rough roads, and think that because the machine was oiled when they started it should be able to get along, no matter how it is used, until the next day. Some men, like the doctor here for instance, use their machines a lot but the trips are short with a stop between, while with others the trips are long and the machine is kept going steady for a much longer time. Then again take the engine that goes into a boat. It does not have the dust that the automobile gets, but it often has to run for hours at a time, and generally every man that has a boat wants it to go for all it is worth. Lots of men neglect their machines but you will not find many who will not kick if there is a knock of any kind, and it keeps a fellow guessing to know how he can leave things loose enough to keep them from making trouble and at the same time have them tight enough to run without making enough noise to make the owner complain. You all know that I use grease on the bearings in my boat, and that I have the fastest boat on this part of the river for her size and the size of the engine that is in her, and that I am always talking grease to every man that has a motor boat; well, the greatest advantage there is in using grease is that bearings can be run looser without knocking than they can be with oil. Next to the man who never gives his engine any care is the one who is always tinkering whether anything is wrong or not. He nearly has a fit every time he hears a sound from his engine above a whisper, and he is not contented until he has tightened everything that can be tightened. I never heard of a fellow of that kind ever loosening anything. The very best thing for people around here to do when they think there in anything wrong with their stuff is to call for me. If it needs fixing I will fix it right, and I will be saving money for them and making it for myself at the same time, and it will save their machines from getting a bad name. But I had better quit talking and get to work or I will have to take up a collection to pay for the time I have been wasting."

John was given to understand that he was to use his own judgment in regard to the job on hand, and from rumors that from time to time could be heard among the gentlemen who owned boats and automobiles they had a good opinion of that judgement.

I am willing to admit that this was self advertisement on the part of John, but who will say that it was not legitimate advertisment for all of that. Machinery, as machinery, does not need much advertisement to have the respect of the world, but how about the men who make it? Look at the position of the machinist in the United States Navy today. Think of your own standing beside that of a doctor, lawyer, school teacher, or even a store keeper. And why is it. Simply because the inside of a shop is an unknown land even in its home community.

I once stood looking at an article that was on the market. It was sold for a trifle, and I could not see how it had been made at all. The price at which it was sold showed expert knowledge on the part of someone. I spoke of it to a friend who was not a mechanic. To him there was nothing surprising in the matter. He dismissed it without thought with the remark, "It might be some trouble to make them by hand, but you can see that this one was made by machinery. Machinery beats any man." Not a thought of the

man who made the machine possible by his knowledge; not a thought of the man who made the machine possible by his skill. And why?

The great doctor or surgeon is known all over the land. Is it entirely because his work outranks yours in importance to the human race?

The great writer has his name in many mouths, and his picture in the Sunday newspapers. Would the wheels of progress stop if his work should be obliterated as they would if yours should be?

In these and numerous other cases these men are great because they are well advertised, and machinery is great because it is well advertised, and machinists are small because they hide their light under a cover, and let the world give the credit to the machine that belongs to the man. W. OSBORNE.

Obituary.

George E. Dana, chairman of the board of directors of the Whitman & Barnes Manufacturing Company, died at his residence, 206 Highland street, Syracuse, N. Y., April 18.

Levi G. Wood died suddenly of pneumonia at his home, 162 West Fourth street, Bayonne, N. J., April 28. At the time of his death Mr. Wood was master machinist of the Electric Launch Company's plant at Bayonne.

Business Items.

The Stanley-G. I. Eectric Manufacturing Company's temporary headquarters at Oakland, Cal., have been moved to 67 Blake Block.

The Toledo Machine and Tool Company, Toledo, Ohio, builder of bar and sheet-metal-working machinery, is compelled, on account of the number of orders on hand, to run a night and day force, running 20 hours a day, in order to make prompt deliveries.

The supply house of C. W. Marwedel, 58 First street, San Francisco, Cal., jobber and dealer in machine-shop supplies and tools, was burned on April 18. A new steel structure will be erected upon the old site. He expects to be temporarily housed at 2472 Union street for business, with a stock on hand, inside of 30 days. As office files were nearly all destroyed, he wants catalogs, price sheets and quotations pertaining to machinists' tools, shop supplies and metal-working machinery.

Manufacturers.

The Zeman Iron Works, Cleveland, Ohio, is erecting a new factory.

The Bittendorf Axle Works, Davenport, Iowa, will erect a new factory.

John Morrell & Company, Ottumwa, Iowa, will erect an artificial-ice plant.

The American Valve Company, Coxsackie, N. Y., will erect a new iron foundry.

The Brown-Lipe Gear Company, Syracuse, N. Y., will erect a new five-story factory.

The Northwestern Expanded Metal Company, Chicago, Ill., will erect a new plant.

The Davison-Namack Foundry Company, Ballston Spa, N. Y., will erect a new plant.

Plans are being prepared for a $15,000 factory for the Home Stove Works, Chicago, Ill.

The Independent Die Company, Brockton, Mass., will build three additions to its plant.

The Great Northern Paper Company, Bangor, Me., will erect a new pulp and paper mill.

The United Shoe Machinery Company is making additions to its plant in Beverly, Mass.

The plant of the Hilty Lumber Company, Milwaukee, Wis., destroyed by fire, will be rebuilt.

The Hill Clutch Company, Cleveland, Ohio, will erect a foundry at its plant, to cost $20,000.

A new $60,000 steel shop will be built for the Western Steel Car and Foundry Company, Chicago, Ill.

The Milwaukee-Highland Mining Company, Highland, Wis., contemplates the erection of a 50-ton mill.

The Warner Gas Fixture Company, Philadelphia, Pa., will make alterations and additions to its plant.

A two-story addition is being built to the foundry of the Williamson Bros. Company, Philadelphia, Pa.

The Martin Dyeing and Finishing Works has commenced the erection of a new plant in Bridgeton, N. J.

The Nordeen Iron Works has been formed in Everett, Wash. J. G. Nordeen and H. G. Nordeen, proprietors.

Messrs. Arbogast & Bastian, Allentown, Pa., are building a packing plant to replace the one destroyed by fire.

Clayton Bros., Bristol, Conn., scissors manufacturers, will establish a new foundry and make their own castings.

The Charles F. Netzow Manufacturing Company, Milwaukee, Wis., will build a $75,000 piano-manufacturing plant.

The Kansas City (Mo.) Motor Car Company will locate a factory in Kenosha, Wis., which will employ 300 men.

The Wolstincroft Felt Manufacturing Company, Philadelphia, Pa., will erect two new factories at a cost of $18,600.

The International Railway Company, Buffalo, N. Y., will erect a new electrical substation, at a cost of $100,000.

Edward Miller & Company, Meriden, Conn., manufacturers of tinners' hardware, lamps, etc., will put up new buildings.

The Buick Motor Works, Flint, Mich., will enlarge its plant by the erection of a three-story addition, to cost $50,000.

Catalogs.

Chain Belt Company, Milwaukee, Wis. May 1, 1906, price list of standard detachable chain belt.

Wellman-Seaver-Morgan Co., Cleveland, O. Catalog describing electric hoists. Illustrated, 6x9, pp. 36, paper.

Leighton Machine Company, Manchester, N. H. Catalog of automatic knitting machines. Illustrated, 6x9, pp. 21, paper.

Acme Ball-Bearing Co., Chappaqua, New York. Catalog No. 7, of Acme ball-bearing jacks. Illustrated, 6x9, pp. 18, paper.

The Bristol Company, Waterbury, Conn. Bulletin No. 39, containing price list of Bristol patent steel belt lacing. Illustrated.

Syracuse Tool Company, 123 Liberty street, New York. Circular illustrating and describing the Syracuse nipple chuck for ¼ to 2-in. pipe.

C. M. Giddings, M. E., Rockford, Ill. Pamphlet showing sample designs of gas and gasolene engines and castings furnished. 3½x8½, paper.

Ingersoll-Rand Company, 11 Broadway, New York. Catalog R 10 A, describing "Imperial" type X air compressors. Illustrated, 6x9, pp. 32, paper.

The Oliver Machinery Company, Grand Rapids, Mich., manufacturer of woodworking machinery, has secured permit for the erection of its new plant.

Edward Gunster, Alexander Farnham and others of Wilkes-Barre, Pa., have formed a company for the purpose of manufacturing the Kitsel storage battery.

The Reed & Barton Corporation, Taunton, Mass., manufacturing silver-plated ware, will increase the capacity of its plant by the erection of three new buildings.

The Engineering Specialty Company, 143 Liberty street, New York, and Meriden, Conn., will erect a plant in Stanford for the manufacture of motors, generators, etc.

Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. Bulletin No. 604, May, 1906, describing the Wright demand indicator. Illustrated, 6x9, pp. 16, paper.

The L. L. Lord Company, Meadville, Pa. 1906 catalog of tools for machinists, gas and steam-fitters, gas, water and electric companies, etc. Illustrated, 4x6½, pp. 39, paper.

The Jefferson (Ga.) Canning Company has been organized and a plant is being erected. Capital $10,000. Hon. James L. Williamson, clerk of the city court of Jefferson, is president.

The Minneapolis (Minn.) Threshing Machine Company will erect a new $15,006 structure in Kansas City, Mo., to increase the capacity of its branch factory at the latter place.

The American Laundry Machinery Company, Station H, Cincinnati, O. Catalog J, describing laundry machinery and appliances, also engines and boilers. Illustrated, 9x12, pp. 123, paper.

Ingersoll-Rand Company, 11 Broadway, New York. Folder, form 35-D, showing several types of air and gas compressors. Folder, form 74-A, describing briefly compressed-air pumping systems.

The Palmetto Manufacturing Company is being organized in Nashville, Tenn., for the manufacture of ax, hoe and hatchet handles. Capital, $25,000. W. H. Cooper, John S. Woodall, etc., incorporators.

Murray Iron Works, Burlington, Iowa. Catalog No. 56, describing Corliss engines, air compressors, pumping engines, boilers, feed-water heaters and complete power plants. Illustrated, 9x12, pp. 72, paper.

The Monarch Manufacturing Company, Des Moines, Iowa, has filed articles of incorporation and will engage in the manufacture of ice and cold-storage machinery. Capital, $50,000. Incorporators, W. D. De Mont, C. J. Bristol and W. D. Sanford.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin 1073, illustrating and describing multiphase revolving field belted generators. Bulletin No. 1077, illustrating and describing small direct current generators, type ML. Instruction Book No. 3023 of Type K multiphase induction integrating watt-meters.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Information regarding turbine air compressors. Box 532, AMER. MACHINIST.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Mechanical and freehand drafting, tracing and lettering a specialty. Walter J. Bitterluh, 33 Dexter avenue, Watertown, Mass.

Wanted—Articles to manufacture in either iron or wood by well-equipped foundry and machine shop. Ypsilanti Machine Works, Ypsilanti, Mich.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Wanted—High-grade designer of hoisting engines for Western concern. Give details of experience and salary expected. Call, write, Hapgoods, Suite 511, 309 Broadway, N. Y.

Wanted—A chance to send a sample copy of The Engineering Agency Weekly Bulletin, giving full list of technical positions open. Write today. The Engineering Agency, Inc., 128 Monadnock Block, Chicago, Ill.

Shop Organizer—Little defects in tools, product and shop organization consume profits. For a moderate outlay I will visit your factory and reduce your manufacturing cost to the minimum. Thirty years' experience. C. E. Tower, 1237 Monadnock Bl., Chicago.

Trained men are in constant demand at high salaries. Our seven weeks' course fits you to drive, maintain and repair all gasolene cars. Day and evening classes. Inspection of building solicited. New York School of Automobile Engineers, 146 West Fifty-sixth street, New York.

Tool catalog No. 22, 950 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

For Sale.

For Sale—Foundry, wood and iron machine shops, Albion, N. Y. Box 74.

For Sale—Full automatic 60-inch gear cutter, in first-class condition. Box 1759, Pittsburg, Pa.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AMERICAN MACHINIST.

For Sale—Drawings, patterns and finished parts for 3 and 4-cylinder four-cycle marine engines, modern design, with latest improvements. Box 498, AMERICAN MACHINIST.

Business Opportunities.

Wanted—A manufacturer to build machines in the printing line in lots from six to twelve. State full particulars, location, etc. Box 546, AMERICAN MACHINIST.

To arrange with party interested to furnish capital to complete design and finish model typewriter; some patents allowed. Box 537, AMERICAN MACHINIST.

I have a modern shop; also some cash. Can offer good chance to skilled machinist who has money and wants to get into manufacturing. If he has some good specialties, better still. Box 517, AMER. MACHINIST.

Manufacturer's Opportunity—To a well-equipped machine shop with $100,000 capital I can bring the opportunity to manufacture one of the best special lines connected with building industry for which there is constant and profitable demand, and upon which I have secured a number of patents. Address Box 523, AMERICAN MACHINIST.

Wanted—To arrange with a machine shop having a reasonably modern equipment for manufacture of machine tools. Would lease or arrange on contract basis. Must have 48" planer, 60" horizontal boring mill, turret lathes, grinders, etc. Reply, giving location and general information. Strictly confidential. Box 533, AMERICAN MACHINIST.

Wanted—High-grade engineering salesman to manage a department for well-known machinery houses in New York. Fine opportunity and attractive salary for man of exceptional ability who can show results. Must be thoroughly familiar with territory and be in position to invest from $2000 to $5000. In writing, give full details as to previous record and present salary and position. Address "Engineer," 434, AMERICAN MACHINIST.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Position as foreman of machine room; references. Foreman, 544, AM. MACH.

Wanted—Position as master mechanic by first-class mechanic; first-class references. Mechanic, 543, AMERICAN MACHINIST.

DELAWARE.

Mechanical draftsman and designer desires position in or near New York. Box 557, AMERICAN MACHINIST.

IOWA.

Chief draftsman; a mechanical engineer, at present chief draftsman with a large manufacturing concern in the West. Box 269, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman, 4 years' experience, wishes change. Box 550, AMERICAN MACH.

Mechanical draftsman wishes position. Address Box 556, AMERICAN MACHINIST.

Works manager or superintendent, located near New York City, will be open for position by June 1. Box 516, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman, with 9 years' experience, wishes to change. Box 553, AM. M.

Mechanical draftsman and designer, specialist in automatic machines, desires change. Box 558, AMERICAN MACHINIST.

Cost accountant, wide experience, competent to install and direct modern efficient system. Box 549, AMERICAN MACHINIST.

Master mechanic, designer; competent to build, improve special automatic machinery; reliable estimator. Box 560, AMER. MACH.

Draftsman of 7 years' experience designing tools, fixtures and special machinery, desires position. 43 Jackson st., Palmyra, N. Y.

Factory cost accountant; young man, experienced, thorough knowledge of modern cost accounting, desires position. Box 551, AMERICAN MACHINIST.

First-class machinist, with steel-edged experience in place of gilt-edged references, open for engagement; good on lathe. Box 561, AMERICAN MACHINIST.

Production engineer, purchasing agent, cost accountant, familiar with premium system, 10 years' experience, good systematizer, desires position. Box 555, AMERICAN MACHINIST.

Superintendent or general foreman, 20 years' experience; specialty, heavy machinery; familiar with up-to-date methods, desires change. Box 559, AMER. MACHINIST.

Gentleman of large experience in machinery business, has traveled extensively, wants position as salesman or take charge of office with manufacturer. Box 562, AMER. MACH.

Superintendent — Specialty, typewriters' equipment, machine and tool design production; 20 years in charge, 30 years' shop experience. Box 536, AMERICAN MACHINIST.

Position as superintendent or general foreman in plant manufacturing steam, marine, gas or gasolene engines; general mill machinery; fine grade automatic machinery. Box 462, AMERICAN MACHINIST.

General foreman, taking entire charge of machine shop or manufacturing plant, successful in producing first-class work at satisfactory cost, varied experience, practical mechanic, desires change. Box 482, AM. MACH.

Assistant to president or manager, manufacturing business; young technical man, with excellent experience in machine and foundry lines; capable not only discovering losses, but persistent and tactful enough to correct same. Box 565, AMERICAN MACHINIST.

A business woman of experience wants a position as advertising manager of a manufacturing concern in Eastern territory. Has had charge in two large concerns and refers to both. Capable of writing all ads, booklets, catalogs, etc; familiar with all details of printing and illustrating. Box 542, AM. M.

Manager or superintendent; experienced man of energy, judgment and reliability; technical and wide practical knowledge; have unquestionably demonstrated ability to accomplish material results; excellent machine and foundry experience; iron, steel and brass. Permanent connection desired. Box 564, AMERICAN MACHINIST.

Business Representative and Engineer — I have had successful experience as chief salesman of home office and manager of two outside offices (same company); territories being East, Middle West and Southwest. Am now consulting engineer improving machinery product for manufacturing company having headquarters in New York City. I desire to change work of broader activity and solicit a position as business representative where engineering experience is useful. Address Box 524, AMERICAN MACHINIST.

OHIO.

Mechanical engineer, 37, thorough practical experience in shops and drafting room, technical, executive ability and commercial training, desires correspondence with firms having prospective openings. Box 522, AM. M.

PENNSYLVANIA.

Wanted—Position as gas-engine expert; technical education, experienced in designing, erecting and operating large units up to 1200 h.p. on producer or blast-furnace gas; 8 years' experience, 2 years with large German manufacturer; perfectly acquainted with best European and American practice. Box 530, AMERICAN MACHINIST.

Position as paymaster, branch office manager or treasurer with manufacturing concern who appreciate and remunerate loyalty to business; long experience with mill records, payrolls and general office work. Can make good, so don't hesitate to bid for my services. Address A. W. F., Room 303, Bank of Savings Building, Pittsburg, Pa.

FOREIGN.

Foreign trade (machine toolmakers) Englishman (35, unmarried), with wide European experience, desires berth with first-class firm; good accountant, correspondent, and well up in factory costs; first-class salesman, thoroughly acquainted with all European and foreign buyers; first-class references; moderate salary. Address Box 999, AMERICAN MACHINIST, 6, Bouverie street, London, England.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Draftsmen experienced on fixtures and dies for light interchangeable work. Address, giving details of experience and expectations, Box 514, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

DISTRICT OF COLUMBIA.

Wanted—Master machinist, $6 per diem. A competitive examination will be held for the above position May 15, 1906. For further information address "Commandant, Navy Yard, Portsmouth, N. H."

GEORGIA.

Wanted—Two or three each, Gisholt and Jones & Lamson turret lathes, second-hand. DeLoach Mill Mfg. Co., Atlanta, Ga.

Wanted—Foreman for small machine shop; one who thoroughly understands duplicate turret and screw machine work, and can make tools and jigs, and understands brass finishing and close accurate work. Write, giving age, full experience in this line of work and salary expected. Bostrom-Brady Mfg. Co., Atlanta, Ga.

ILLINOIS.

Factory superintendent wanted in gasolene engine factory, located in Central Illinois. One who can get out the work and reduce cost. Address, Havana Manufacturing Co., Havana, Ill.

Required for a small arms factory abroad, an educated engineer with experience of very high-class interchangeable work produced by the latest automatic and repetition methods. Must be active, energetic, thoroughly at home in jig and fixing work and up to date generally. Write fully as regards experience and salary expected, also stating age, etc. Box 520, AMERICAN MACHINIST.

KENTUCKY.

Wanted—Foreman for stamping department of sheet-metal works. Write for partic-

ulars, stating age, experience and references. Box 539, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—At once, several jig makers and scraper hands. We can offer good wages and permanent positions to the right men. Apply Campbell Printing Press Mfg. Co., Taunton, Mass.

Wanted—Two first-class toolmakers; pleasant shop and surroundings. For steady, capable men positions will be permanent. In answering state age and experience, if married or single, and wages expected. Factory twenty miles from Boston. Box 518, AM. M.

Wanted—Several young men for installers in New England for delicate automatic machinery. Experience in construction, assembling or installing such machinery is essential. State age, wages required, previous experience and give references. Box 503, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center, and is one of the finest cities in this country. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern up-to-date methods. Competent men who are experienced and will "do things right" can secure permanent employment at first-class wages. State age, experience, references, wages, and give full information. Cadillac Motor Car Co., Detroit, Mich.

MINNESOTA.

Wanted—First-class machinists, moulders and pattern-makers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel & Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Wanted — Mechanical draftsman having some experience in design; must be good at detailing. Box 534, AMERICAN MACHINIST.

Wanted—First-class lathe and vise men for small steel work. Steady work, good pay, no trouble. Twenty-five miles from New York City. Box 194, AMERICAN MACHINIST.

Draftsman for jigs and fixtures; one with experience in designing light machinery preferred. State age, experience and salary expected. Box 540, AMERICAN MACHINIST

Young man to make free-hand sketches of machine parts, either from working drawings or from the machine. Applicants must be able to letter neatly. Box 541, AMER. MACH.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—A first-class designer on tools for production of interchangeable parts of small and medium size machinery. Must be capable of looking after several other draftsmen. State age, experience, references and salary expected. Address reply to Box 547, AM. M.

NEW YORK.

First-class machinist wanted on automobile experimental work. Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Working foreman on meter indicators who can operate B. & S. Automatics. Box 531, AMERICAN MACHINIST.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

First-class mechanical draftsmen desired; state age, experience and salary expected. Box 507, AMERICAN MACHINIST.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Foreman for assembling department; must be a man of ability and furnish A-1 references. Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Pattern-makers Wanted—Several first-class wood pattern-makers; pay 42c. per hour to good men; open shop; large plant, half hour above New York; 54 hours week. Address Box 552, AMERICAN MACHINIST.

Wanted—Chief draftsman of wide experience on web printing presses. Excellent opportunity. State age, experience, and salary desired. All communications held strictly confidential. Box 476, AMER. MACHINIST.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hours work day; time and a half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

Draftsmen Wanted—First-class electrical mechanical draftsmen; only practical, experienced men need apply. State age, experience, reference, and salary expected. Permanent position if satisfactory. Address Box 548, AMERICAN MACHINIST.

Wanted—A skilled machinist in a manufacturing company as assistant foreman; about 30 years of age; one who desires to advance himself and who would purchase or gradually acquire an interest; a good opportunity for a hustler. Write, giving full details as to experience, etc. Box 554, AMER. MACHINIST.

OHIO.

Gisholt operator wanted, to take charge of several lathes on contract work. Address Box 525, AMERICAN MACHINIST.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 455, AMERICAN MACHINIST.

Wanted—A first-class machine draftsman for automobile work, one who has had considerable experience in this class of work desired. Address "Machine Draftsman," Box 538, AMERICAN MACHINIST.

Wanted—First-class gas-engine designer, one having experience in designing four-cylinder automobile engines, by one of the largest automobile manufacturers in this country. Address "Engine Man," AMERICAN MACHINIST.

The National Metal Trades Association can place a few first-class wood pattern-makers, tool-makers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, Ohio.

PENNSYLVANIA.

Wanted—Good toolmakers and machinists, familiar with Government work. Box 451, AMERICAN MACHINIST.

Foreman, experienced in all branches of gear cutting, to take full charge of twenty-six machines. Box 513, AMERICAN MACHINIST.

Wanted—Several first-class scrapers, also planer and lathe hands, for machine tool work. Address Colburn Machine Tool Company, Franklin, Pa.

Riveter Wanted—An experienced man who understands running double-stroke headers. Steady employment with good wages to the right party. Address 1616 North 21st Street, Philadelphia, Penn.

Wanted—Foreman accustomed to rapid production of interchangeable work; must be energetic and accustomed to handling help. Reply, giving full experience, present occupation and salary expected. Box 499, AM. M.

Wanted—Foreman for drop-forging department in new and modernly equipped plant; must be thoroughly posted and experienced and with good references. Executive ability and ability to handle men the first requisite. Box 535, AMERICAN MACHINIST.

Wanted—A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred. Only first-class men need apply. Address Chief Draftsman, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa. (P. O. Box 911).

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: character, common sense, experience with automatic machinery, (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Unusual opportunity for a man with mechanical ability to work into a position of responsibility. Must be energetic, tactful and a good executive, capable of handling men, and a good machinist. Plant located in Wisconsin. Reply, giving full experience, present occupation, and salary desired. Box 309, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—A young, energetic machine-shop foreman, up-to-date in modern practice in manufacturing; also a man who knows how to take advantage of jobbing business, by a strictly open shop in Seattle, Washington. Line of manufacture: fire hydrants and water-works goods Could use two or three other good mechanics in the line. Box 500, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co	96
Acme Machinery Co	34
Adams Co	9
Albro-Clem Elevator Co	93
Alliance Machine Co	106
Allington & Curtis Mfg. Co	91
Almond Mfg. Co., T. R	101
Alteneder & Sons, Theo	34
American Gas Furnace Co	14
American Pulley Co	97
American Tool & Machine Co	106
American Tool Works Co	8
American Tube and Stamping Co	105
Armstrong Bros. Tool Co., 26 and	102
Auburn Ball Bearing Co	89
Aurora Tool Works	83
Automatic Machine Co	95
Baker Bros.	26
Baird Machinery Co	85
Baldwin Chain & Mfg. Co	96
Baldwin Steel Co	81
Barnes Co. B. F	10
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E	82
Bay State Stamping Co	102
Bay State Tap & Die Co	99
Bay State Tool Co	96
Beaman & Smith Co.	15 and 100
Becker-Brainard Milling Machine Co	23
Bertram & Sons Co., John	20
Besly & Co., Chas. H	99
Bethlehem Fdry. & Mach. Co	95
Bickford Drill & Tool Co	1
Bignall & Keeler Mfg. Co	90
Bilgram, Hugo	34
Billings & Spencer Co	103
Binsse Mach. Co	34
Birdsboro Steel Fdry. & Mach. Co	73
Blaisdell Machinery Co	102
Blanchard Machine Co	34
Bliss Co., E. W	25
Bliss Electrical School	102
Blount Co., J. G	97
Boker & Co., Hermann	79
Boston Gear Works	92
Boynton & Plummer	104
Bowers, E. J	98
Bradford Machine Tool Co	5
Bridgeport Safety Emery Co	96
Bristol Co	4th cover
Brown-Cochran Co	94
Brown & Co., R. H	100
Brown Hoisting Machine Co	107
Brown & Sharpe Manufacturing Co	4th cover and 69
Buffalo Forge Co., 4th cover and	82
Builders Iron Fdry	3rd cover
Bullard Machine Tool Co	32
Bury Compressor Co	102
Butler, A. G	88
Calculagraph Co	91
Caldwell & Son Co. H. W	93
Carborundum Co	10
Card Mfg. Co., S. W	17
Carpenter Tap & Die Co., J. M.	89
Case Mfg. Co	107
C & C Electric Co	24
Chambersburg Eng. Co	88
Champion Tool Works	97
Chandler & Farquhar Co	86
Chattanooga Machinery Co	88
Chicago Rawhide Mfg. Co	92
Chisholm & Moore Mfg. Co	106
Cincinnati Electrical Tool Co	88
Cincinnati Machine Tool Co	10
Cincinnati Milling Mach. Co., 6 and	7
Cincinnati Planer Co	9
Cincinnati Shaper Co	110
Clark Cast Steel Cement Co	104
Clark, Jr. & Co., Jas	90
Cleveland Automatic Mach. Co	18
Cleveland Crane & Car Co	106
Cleveland Twist Drill Co., 4th cover	
Cleveland Wire Spring Co	25
Clough, R. M.	104
Coates Clipper Mfg. Co	89
Coes Wrench Co	33
Colburn Machine Tool Co	22
Columbus Machine Co	94
Cook Co., Asa S	98
Crescent Forgings Co	107
Cresson Co., Geo. V	101
Crocker-Wheeler Co	28
Crosby Steam Gage & Valve Mfg. Co.	17
Cumberland Steel Co	89
Curtis & Co. Mfg. Co	106

	PAGE
Curtis & Curtis Co.	104
Cushman Chuck Co.	100
Davis, Rodney	92
Davis Machine Co., W. P.	84
Detrick & Harvey Mfg. Co.	90
Diamond Machine Co.	3rd cover
Diehl Mfg. Co.	26
Dill Machine Works, T. C.,	20 and 84
Dixon Crucible Co., Joseph	95
Dodge & Day	98
Double Friction Coil Clutch Co.	26
Dreses Machine Tool Co.	108
Durbrow & Hearne Mfg. Co.	95
Dwight Slate Machine Co.	83
Earle Gear & Mach. Co.	92
Eberhardt Bros. Mach. Co.	86
Eck Dynamo & Motor Works.	26
Elliott Chemical Works	83
Elmes Eng. Works, Chas. F.	102
Equipoise Rivet Co.	86
Errington, F. A.	101
Evans Friction Cone Co.	95
Excelsior Needle Co.	104
Fairbanks Co.	85
Farrel Fdry. & Mach. Co.	89
Fawcus Machine Co.	92
Fellows Gear Shaper Co.	92
Fenn-Sadler Machine Co.	26
Firth Sterling Steel Co.	105
Fitchburg Machine Works	31
Foos Gas Engine Co.	94
Fosdick Machine Tool Co.	16
Franklin Mfg. Co., H. H.	110
Frevert Mach. Co.	106
Gang Co., Wm. E.	88
Gardner Engineering Co.	96
Gardner Machine Co.	96
General Electric Co.	28
General Pneumatic Tool Co.	109
Geometric Tool Co.	25
Gleason Works	4th cover
Goldschmidt Thermit Co.	104
Goodell-Pratt Co.	86
Gorton Machine Co., Geo.	26
Gould & Eberhardt	82
Graham Mfg. Co.	88
Grant Gear Works	92
Gray Co., G. A.	34
Gray & Prior Machine Co.	102
Greaves, Klusman & Co.	91
Greendale Gas Engine Co.	94
Greenwald Co., I. & E.	93
Hammacher, Schlemmer & Co.	75
Hampden Corundum Wheel Co.	92
Harrington, Son & Co., Edw.	108
Hendey Machine Co.	77
Henley Publishing Co., N. W.	83
Henry & Wright Mfg. Co.	87
Heppenstall Forge & Knife Co	104
Hess-Bright Mfg. Co.	106
High Duty Saw & Tool Co.	73
Hill, Clarke & Co.	85
Hisey-Wolf Machine Co.	20
Hoefer Mfg. Co.	14
Holbrook Mfg. Co.	94
Horsburgh & Scott Co.	4th cover
Horton & Son Co., E.	100
Hunt Co., C. W.	98
Hunt & Co., Robt. W.	90
Hyatt Roller Bearing Co.	89
Ingersoll Milling Machine Co.	98
Ingersoll-Rand Co.	103
International High-Speed Steel Co.	104
Iroquois Machine Co.	97
Jacobs Mfg. Co.	100
Jacobson Mach. Mfg. Co.	94
Jantz & Leist Electric Co.	26
Jeffrey Mfg. Co. The	84
Jenkins Brothers	95
Johnson Mach. Co., Carlyle	33
Jones & Co., B. M.	104
Jones & Lamson Machine Co.,	12, 13 and 34
Kenneson, Emley & Rubino	87
Kent & Co., Edwin R.	104
Kilbourne & Jacobs Mfg. Co.	98
King Machine Tool Co.	99
Kreiger & Nelson Tool Co.	20
Landis Machine Co.	94
Landis Tool Co.	71
Lapointe Machine Tool Co.	106
LeBlond Machine Tool Co., R. K.	4th cover
LeCount Wm. G.	100
Link-Belt Engineering Co.	81
Lodge & Shipley Machine Tool Co.	4
Long & Allstatter Co., The	20
Lumen Bearing Co.	107
Lunkenheimer Co., The	95
Lyon Metallic Mfg. Co.	87
Main Belting Co.	88
Maris Brothers	106
Marshall & Huschart Mach. Co.	85
Massachusetts Saw Works	89
McCabe J. J.	84 and 101
McGeorge Mfg. Co.	86
McInnes Steel Co.	104
Merrell Mfg. Co.	89
Merrill Bros.	88
Merritt & Co.	96
Mfg. Equipment & Eng. Co.	102
Michigan College of Mines	100
Mietz, A	94
Millers Falls Co.	90
Miner & Peck Mfg. Co.	100
Modern Machinery Daily News	83
Moore Co., Franklin	98
Morris Foundry Co., John B.	15
Morse Chain Co.	86
Morse Twist Drill & Machine Co.	33
Morse, Williams & Co.	89
Motch & Merryweather Machine Co.	85
Mueller Machine Tool Co.	101
Mutual Machine Co.	86
National-Acme Mfg. Co.	110
Nazel Engineering and Machine Works	88
New Britain Machine Co.	94
New Era Gas Engine Co.	94
New Haven Mfg. Co.	83
New Process Rawhide Co.	93
Newton Machine Tool Works.	11
Nicholson File Co.	17
Nicholson & Co., W. H.	91
Niles-Bement-Pond Company,	84, 111, 112, 113, 114
Northern Electrical Mfg. Co.	29
Northern Engineering Works.	106
Norton Emery Wheel Co.	79
Norton Grinding Co.	30
Nuttall Co., R. D.	92
Nutter, Barnes & Co.	20
Obermayer Co., S.	91
O. K. Tool Holder Co.	85
Omega Steel & Tool Co.	104
Owen Machine Tool Co.	22
Parker Co., Chas.	88
Patterson, Gottfried & Hunter, Ltd.	82
Pawling & Harnischfeger	106
Paxson Co., J. W.	83
Philadelphia Bourse	106
Philadelphia Gear Works	92
Phillips-Laffitte Co.	84
Poole Co., J. Morton	31
Potter & Johnston Mach. Co.	77
Pratt Chuck Co.	100
Pratt & Whitney Co.	2 and 3
Prentiss Tool & Supply Co.	84
Prentiss Vise Co.	88
Queen & Co.	89
Ransom Mfg. Co.	96
Reed Mfg. Co.	88
Reeves Pulley Co.	22
Reichheim & Co., E. P.	4th cover
Rivett-Dock Company	3d cover
Rivett Lathe Mfg. Co.	3d cover
Rockford Machine Tool Co.	90
Rockwood Mfg. Co.	91
Rogers Works, John M.	98
Rowbottom Machine Co.	95
Safety Emery Wheel Co.	96
Sames, C. M.	101
Saunders Sons, D.	88
Sawyer Gear Works	92
Schieren & Co., Chas. A.	83
Schumacher & Boye	9
Schwerdtle Stamp Co.	98
Scranton & Co.	98
Sebastian Lathe Co.	98
Sellers & Co., Wm.	21
Seneca Falls Mfg. Co.	20
Shelby Steel Tube Co.	104
Shultz Belting Co.	83
Sibley Machine Tool Co.	94
Simonds Mfg. Co.	93
Skinner Chuck Co.	100
Sloan & Chace Mfg. Co.	34
Slocomb Co., J. T.	31
Smith & Mills	83
Soltmann, E. G.	89
Spacke Machine Co., F. W.	102
Speed Changing Pulley Co.	26
Spicer Universal Joint Mfg. Co.	98
Sprague Electric Co.	28
Springfield Machine Tool Co.	99
Standard Engineering Works.	86
Standard Gauge Steel Co.	93
Standard Machinery Co.	86
Standard Tool Co.	97
Stanley-G. I. Elec. Mfg. Co.	90
Stark Tool Co.	89
Starrett Co., L. S.	16
Steptoe Shaper Co., John	94
Stevens, F. B.	91
Stoever Foundry & Mfg. Co.	91
Struthers-Wells Co.	94
Sturtevant Co., B. F.	27
Switchboard Equipment Co.	27
Taylor-Wilson Mfg. Co.	92
Three Rivers Tool Co.	86
Toomey, Frank	84
Triumph Electric Co.	26
Trump Bros. Machine Co.	100
Turner Brass Works	95
Underwood & Co., H. B.	102
Union Twist Drill Co.	75
United Eng. & Foundry Co.	105
U. S. Watch Tool Co.	83
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Van Dyck Churchill Co.	30
Veeder Mfg. Co.	95
Vitrified Wheel Co.	96
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Waltham Watch Tool Co.	90
Ward & Sons, Edgar T.,	27 and 104
Warner, C. S.	85
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Warner & Swasey Co.	71
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Webster & Perks Tool Co.	101
West Haven Manufacturing Co.	4th cover
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Worcester Mach. Screw Co.	104
Wormer Mach. Co., C. C.	86
Wyke & Co., J.	101
Wyman & Gordon Co.	4th cover
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Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.

The National Bureau of Standards at Washington—I.

Each of the various trades connected with the mechanical arts has its own special classes of tools, peculiar to that one and not used in the others; there is, however, one species of appliance which is used in one form or another, by all of them, and that is, measuring appliances. Day after day, year after year, the making and recording of measurements go on, forming an exceedingly important part of hundreds of different kinds of industries, and with the increase in the number and magnitude of these industries, the extending and interlacing of their commercial relations, the supplanting of rule-of-thumb by scientific methods, and the adoption of the principle of interchangeability, it becomes of greater and greater consequence that there should be no uncertainty about the weights and measures, upon which this great fabric depends. In the AMERICAN MACHINIST, at page 46 of the current volume, we published an article giving a history of the standard weights and measures of the United States, and in that article reference was made to the establishment of the Bureau of Standards, though but a very meager idea was there given as to the functions of the Bureau. Visitors to the Exposition at St. Louis may recall the electrical testing laboratory in the Electrical Building, which was conducted by the Bureau, and to many this was doubtless the first time their attention was directed to even the existence of the Bureau. It is our intention in this article to present some illustrations of this growing governmental institution, and to describe some of the features, and the work being done there along the lines related to the pursuits in which our readers are interested.

Before the establishment of this institution, when work of comparison and standardization required to be done, it was necessary to go to foreign governments, the Physikalisch-Technische Reichsanstalt of Germany being the one which was principally relied upon. At that time the United States had a creditable position in physical science and had some of the best laboratories in the world. It was the leader in the manufacture of electrical and other machinery, and in some kinds of scientific instruments, and yet it was so dependent as to be compelled to go to foreign laboratories for facilities for standardizing. The credit for bringing this state of affairs to the notice of the Government and making a suggestion for its improvement is due to S. W. Stratton, Ph. D.

FIG. 1. NORTH FACADE OF PHYSICAL BUILDING.

FIG. 2. PHYSICAL BUILDING, FROM THE NORTHEAST.

Dr. Stratton graduated from the course of mechanical engineering at the University of Illinois, in 1884, and was retained by that institution as an instructor until 1892, filling successively the positions of instructor, assistant professor, and professor of physics and electrical engineering. In 1892 he was appointed assistant professor of physics in the new University of Chicago, where he remained until 1902, having risen to a full professorship. Some of his work at the University is referred to in the articles on "The Interferometer" commencing at page 772, Vol. 24 (1901). Aside from his attainments as a scientist, Dr. Stratton has always been interested in purely mechanical matters. He has designed many pieces of machinery and scientific apparatus, and has always had a shop in connection with his laboratory in which he could personally superintend their construction. While still at the University of Chicago, and during a visit to Washington, he suggested to the authorities that the Government should have better standardizing facilities, and that we were then dependent upon foreign institutions for such work in many lines. As a result he was called upon to submit a plan for the establishment of a Bureau of Standards. Although Dr. Stratton was originally led to make the suggestion to the Government merely because he per-

ceived the great need of such an institution, it happens that he was himself selected to take charge of the Bureau when organized, and he is today its director. The institution as it now stands is practically the same as outlined in the project which he drew up, but its growth and development have been more rapid than even its most ardent supporters have anticipated. Notwithstanding the exceptional growth of the Bureau, it cannot keep pace with the demands made upon it for testing and standardization by the scientific interests of the country.

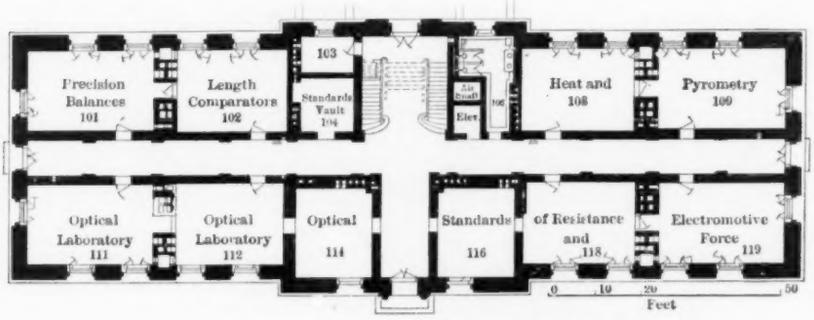


FIG. 3. PHYSICAL LABORATORY—FIRST FLOOR PLAN.

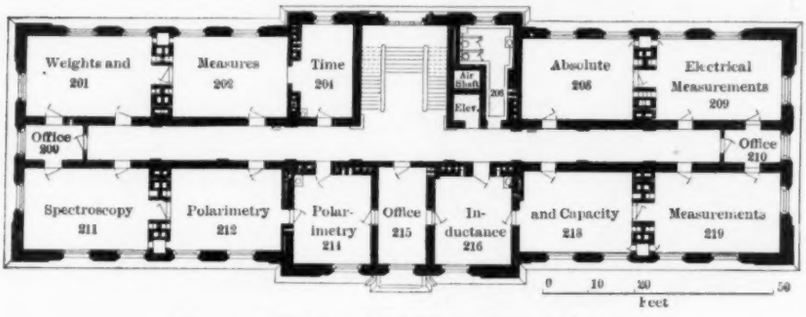


FIG. 4. PHYSICAL LABORATORY—SECOND FLOOR PLAN.

As it would take two or three years to design and build the laboratories required for the Bureau, temporary quarters were secured at the place where the offices of Weights and Measures were located.

The appropriation which Congress promptly made when the matter was called to its attention provided for the building and fitting-out of laboratories and for a small scientific force, the intention being to increase this later when the laboratories were completed. The Act carrying this appropriation, which was the establishment of the Bureau of Standards, was passed March 3, 1901, and the work was commenced at once. After careful consideration of the available sites in the District of Columbia, a site beyond Rock creek in the northwest section of the District, having an area of about 7½ acres, was selected. This site is situated near the intersection of Connecticut avenue extended and Pierce Mill road, about 3½ miles from the White House, in a portion of the District which is at present very little built up, the ground in the neighborhood of the Bureau buildings being pretty well wooded; the site is one of the most beautiful in the District of Columbia, though there still remain to be done some clearing, grading and sodding around the buildings; it is among the highest points of Washington, and as to the amount of fresh air around the place I have a strong recollection, having arrived there one winter day when the mercury was somewhere near zero, and a gale of wind was blowing over the hills. It is the intention to insure the permanent protection of the Bureau from mechanical and electrical disturbances by the purchase of adjacent property.

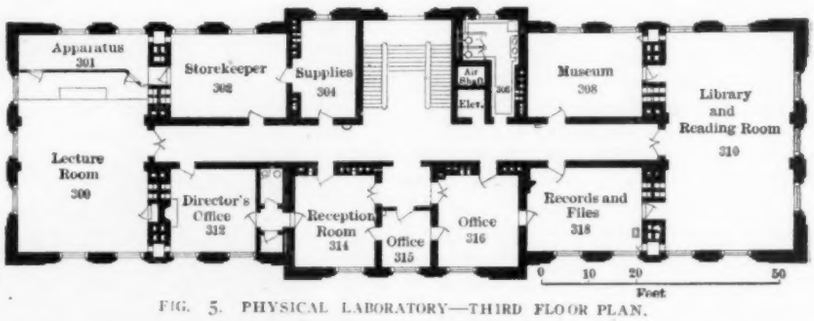


FIG. 5. PHYSICAL LABORATORY—THIRD FLOOR PLAN.

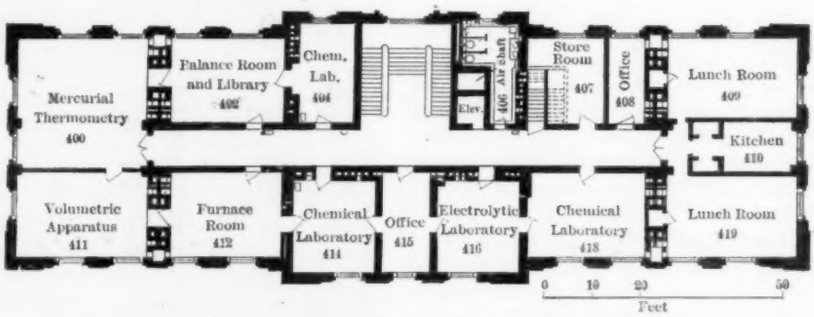


FIG. 6. PHYSICAL LABORATORY—FOURTH FLOOR PLAN.

The experts of the Bureau drew up general specifications for two buildings, one to contain the power plant, machinery for the construction of instruments, and other heavy apparatus, the other to be the physical laboratory building, in which the delicate work should be done, this second building being erected at a considerable distance from the first in order to keep it free from vibration and other disturbances resulting from the machinery. The appropriation for the buildings alone was $325,000, and in accordance with the general specifications prepared by the Bureau and the amount available, the supervising architect of the Treasury Department made plans for two substantial fireproof buildings of dark red brick trimmed with buff Bedford limestone. These buildings were constructed under the supervision of the experts of the Bureau. They were designed so as to enable extensions to be readily made on both the east and the west. To the west of the mechanical laboratory building an additional small building has been nearly completed, this being designed for apparatus for the liquefaction of gases. The present housing of the Bureau, therefore, consists of these three buildings; it is, however, the desire of those in charge of the Bureau to have additional buildings erected as soon as practicable; one of these is to be a building at the opposite end of the mechanical laboratory from the liquefaction or low-temperature building, which is to be devoted to the testing of engineering instruments and the physical properties of materials. It is also proposed to practically triple the size of the physical laboratory building by structures at each end of it, one of which is to be for electrical work, and the other to be a chemical and metallurgical laboratory. The present buildings are connected by subways or tunnels between them, as will appear later, and it is the intention to have the entire group of buildings when completed connected by such tunnels, which will con-

FIG. 7. SOUTH FACADE OF MECHANICAL BUILDING.

tain the numerous pipes and wires that are necessary to serve the various buildings, and will also afford a convenient dry and protected passageway for intercommunication. The present tunnel between the mechanical and physical buildings also serves another purpose, which will be described later.

GENERAL VIEW OF THE BUILDINGS.

In Figs. 1 to 16 are presented plans and general views of the buildings. In making a visit to the Bureau of Standards one would naturally first go to the office of the Bureau, which is situated in the physical laboratory building. This would at the present time be entered from the north facade and in Fig. 1 we have a view of this front of the building. Fig. 2 is another view of the same building, taken from the northeast. In Figs. 3 to 6 are presented plans of four stories of this building. These will be referred to in detail when describing the work done in the different departments.

From the physical laboratory building, one would then walk across the connecting cement sidewalk to the mechanical building, which would be entered by its south front, shown in Fig. 7. The north facade of this building, which faces on the Pierce Mill road, is shown in Fig. 8, the door shown leading into the basement, or floor below the entrance floor of Fig. 7. Figs. 9 to 12 are floor plans of the mechanical laboratory building from basement to attic. Fig. 13 is a plan of the subway connecting the two buildings already referred to. Fig. 14 is a view looking from the southeast, of the low temperature building, already described as being located west of the mechanical laboratory building. Floor plans of this building are given in Figs. 15 and 16.

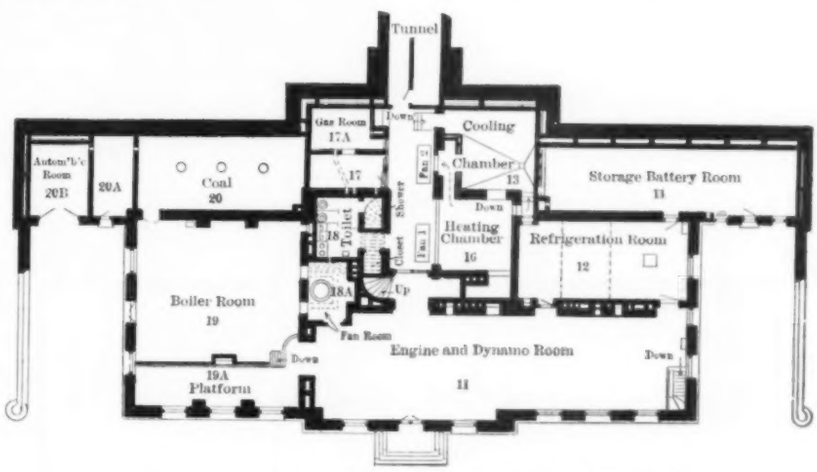


FIG. 9. MECHANICAL LABORATORY—BASEMENT FLOOR PLAN.

FIG. 8. NORTH FACADE OF MECHANICAL BUILDING.

PURPOSES AND ORGANIZATION.

Before proceeding to a detailed description of the buildings, it will be well to give a more definite conception of the objects of the Bureau's existence. I quote from the Act establishing the Bureau, already referred to:

"That the functions of the Bureau shall consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce, and educational intitutions with the standards adopted or recognized by the Government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

"That the Bureau shall exercise its functions for the Government of the

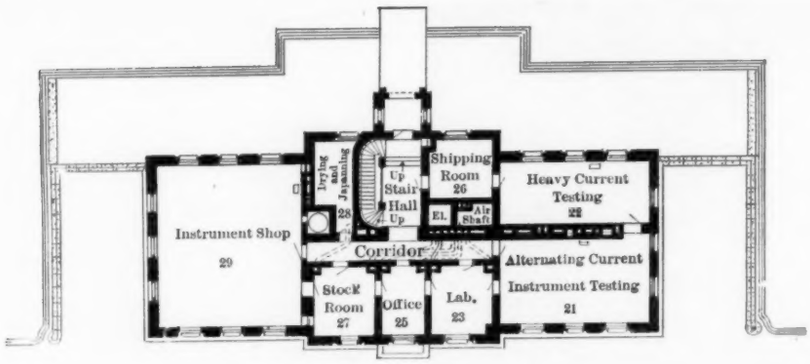


FIG. 10. MECHANICAL LABORATORY—FIRST FLOOR PLAN.

United States; for any State or municipal government within the United States; or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments. All requests for the services of Bureau shall be made in accordance with the rules and regulations herein established."

In order to carry on this work an organization has been devised, in which the different sections are grouped in three divisions, headed respectively by the director himself, the physicist and the chemist. The elaboration of the third division has not yet been completed; the first two divisions are composed of the following sections:

1. Weights and measures, heat and thermometry, light and optical instruments, engineering instruments, the office, and the instrument shop.

2. Resistance and electromotive force, inductance and capacity and absolute measurements, electrical measuring instruments, magnetism, photometry and the engineering plants.

The scientific staff comprises one physicist, one chemist, four associate physicists, one associate chemist, nine assistant physicists, two assistant chemists, 17 laboratory assistants, four aids, four laboratory apprentices; a total of 43 persons. The office and clerical force comprise 16, and the engineering and mechanical personnel, 27.

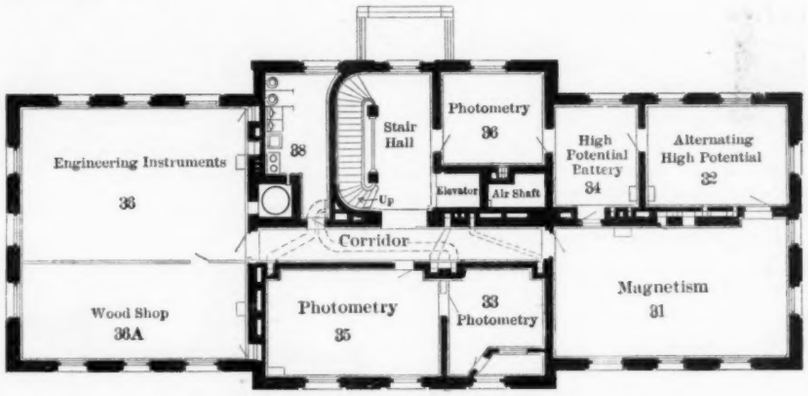


FIG. 11. MECHANICAL LABORATORY—SECOND FLOOR PLAN.

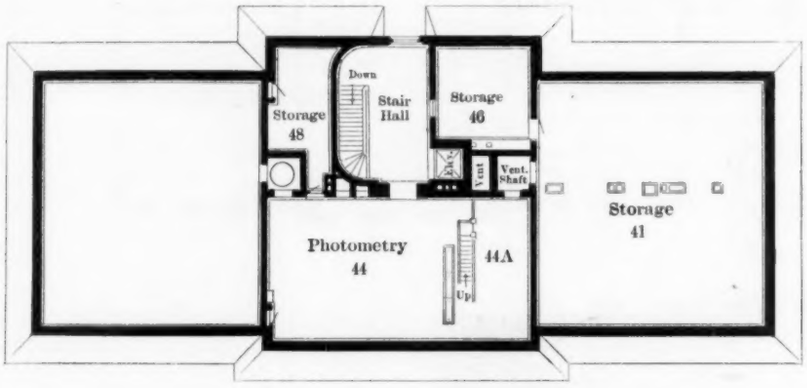


FIG. 12. MECHANICAL LABORATORY—ATTIC FLOOR PLAN.

Section on A-A.

THE MECHANICAL BUILDING.

As the average mechanical man visiting the Bureau would prefer to get over and see the mechanical building before anything else, we shall now describe the equipment contained in this building.

The building, illustrated by Figs. 7 to 12, is 135 feet long from east to west, 48 feet wide at the ends, and 58 feet wide in the center. The mechanical and electrical plant is located in the basement, this floor being one-half as large again as the others in consequence of extensions below the level of the ground, to the south, east and west as seen in Fig. 9. Fig. 17 is a view of the boiler room, showing the northeast corner of the building. As intimated in the previous reference to Fig. 8, the ground is one story lower on the north front of the building, so the power plant receives an abundance of natural light, as can be seen in the pictures, in this respect the boiler room shown being a great contrast to numerous

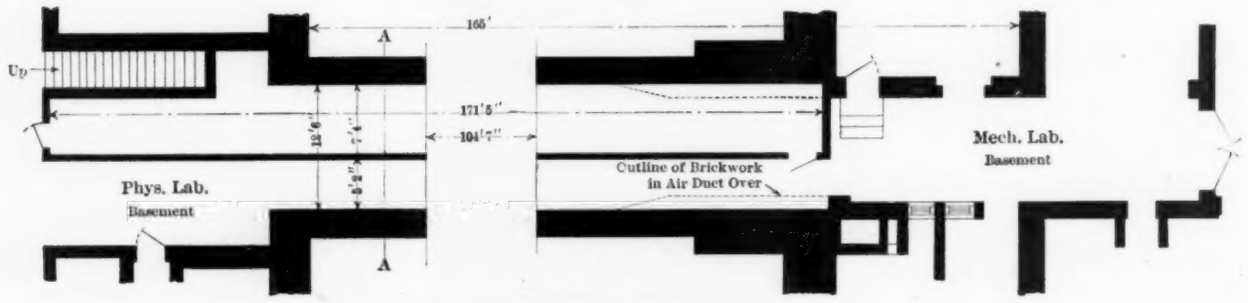


FIG. 13. CONNECTING SUBWAY.

boiler rooms with which one frequently meets. The platform to the left of the picture is on the same level as the engine-room floor, the boiler-room floor being five feet lower. The boiler room is 42 feet square by 19 feet total hight. It, at present, contains two 125-h.p. water-tube boilers, provided with economizer and forced draft. Sufficient space is provided so that the ultimate capacity can be 500 h.p. Upon the platform along the north side of the boiler room, seen to the left in the picture, are located the filters, the electric and steam high-pressure water pumps, boiler feed pumps, feed-water heater, and other auxiliary apparatus. Under the platform are located the heater for the hot-water service, pressure tanks for the cold-water service, storage tank, etc.

FIG. 14. LOW TEMPERATURE BUILDING.

Fig. 18 is a view of the engine and dynamo room, which is 87 feet long and has an average width of 24 feet. The further engine is a tandem compound Harrisburg-Standard of 120 h.p., direct-connected to two direct-current 37.5-kw. generators, each giving 300 amperes at 120 volts, and connected to a 3-wire system. The small engine in the foreground to the right is a 40-h.p. and is also direct-connected to two direct-current generators. The space beyond the large engine is occupied by a variety of apparatus, not all of which was installed at the time that this picture was taken, and of which the following are particulars:

A double motor-driven booster for charging storage cells, having a capacity on each side of 200 amperes at 30 volts, and which is also used alone to charge storage batteries of relatively low e.m.f. and large current capacity.

A pair of two-phase alternators, surface wound and giving an electro-motive force of nearly sine wave form, direct-connected to a driving motor. One machine gives 60 cycles, and the other 180; the two may be placed in series and the wave form varied through wide limits by varying the relative amplitudes and phases of the two waves. By using them separately and varying the speed, considerable ranges in frequency may be obtained.

Another three-machine set contains two 60-cycle, three-phase alternators, the relative phases of which may be varied by shifting the field of one of them. Thus, connecting one to the current coil, and the other to the potential coil of any instrument, any required power-factor may be obtained.

A second smaller set of a similar kind gives two 60-cycle currents of adjustable phase relation. This is useful in calibrating phase indicators as well as testing power-measuring instruments.

A three-phase 120-cycle alternator, driven by an inverted synchronous converter used as a motor, the latter also giving alternating current at 60 cycles.

All these generators are controlled by the appliances mounted on the very nice white marble switchboard seen in the figure. This switchboard also controls six storage batteries arranged in groups of two on the three-wire system, for use in operating the motors when great steadiness of speed is desired, for lighting and power when the engines are not running, and for experimental purposes. There are also several plug-panels which enable the current from any generator or battery to be sent to any laboratory room in

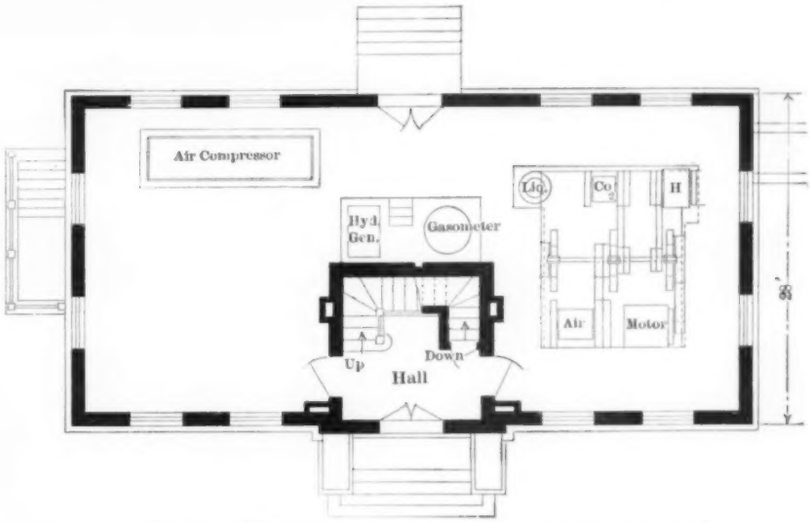


FIG. 15. LOW TEMPERATURE LABORATORY—FIRST FLOOR PLAN.

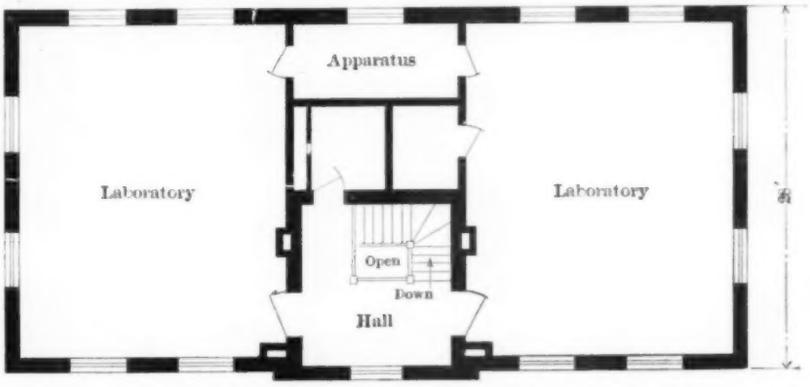


FIG. 16. LOW TEMPERATURE LABORATORY—SECOND FLOOR PLAN.

either building. In the foreground at the left is shown part of a motor-driven exhaust fan for withdrawing fumes from the battery rooms and other rooms of both buildings. It will be noticed that this engine room is very clear and open and free from pipes, wires, etc., avoiding all interference with the use of the hand traveling crane. The live steam and exhaust steam pipes, air-ducts, water, gas, and other piping and the wiring are all located in the sub-basement beneath the engine-room floor.

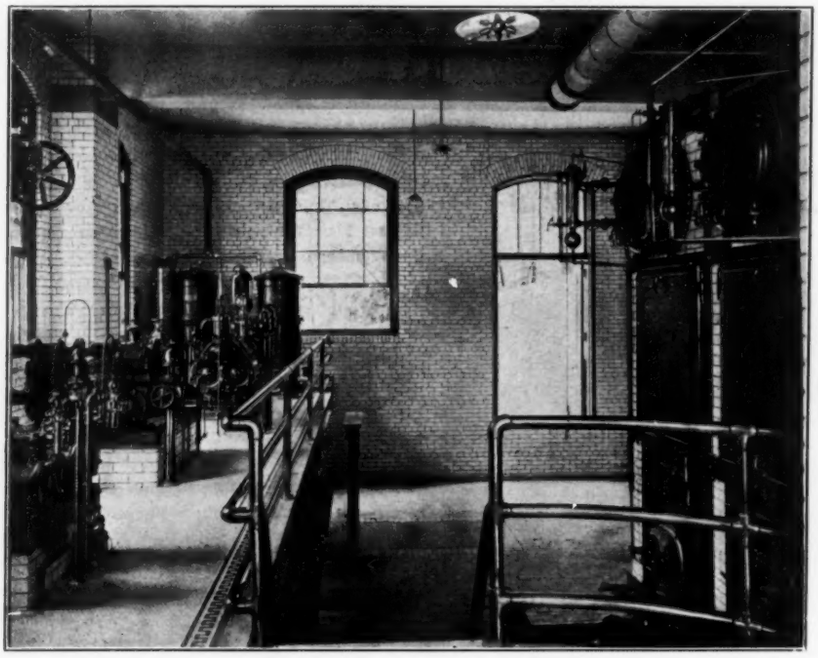


FIG. 17. BOILER ROOM AND PUMPS.

Back of the engine room, as can be seen from the plan Fig. 9, is the refrigeration room, which is 41x18 feet and contains a 30-ton ammonia refrigerating machine of the absorption type, having a capacity equivalent to the melting of ten tons of ice in eight hours, and of which a picture is given in Fig. 19. The object of this apparatus is to furnish low temperatures in small rooms for experimental purposes, to remove moisture from the air of laboratory rooms in order to obtain a dry atmosphere in hot or wet weather, and for making ice. The cold brine is pumped from the machine through a system of piping around both buildings, so that it may be used in almost any of the laboratory rooms. When this brine flows through a coil of pipe in a room, it condenses moisture out of the atmosphere and reduces the humidity some thirty points according to the surface exposed. Thus electrical surface leakage may be so far reduced that precision measurements may be made in the hottest and dampest summer weather; moreover the temperature of the laboratory may be controlled at the same time, the gradual rise of temperature during the day being prevented. The rate of absorption of heat may be regulated by varying the speed of the fan which blows air against this cold brine coil. It is not necessary to run the machine every day, except in summer, because there has been provided in the sub-basement beneath the refrigerating room a large tank of calcium-chloride brine in which resides a considerable heat-absorption capacity.

Back of the refrigerating room in the southwest corner of the basement is the storage-battery room, which is 61 feet long and contains the following chloride cells:

Four batteries of 66 cells each, 200 ampere-hour capacity.

Two batteries of 66 cells each, 400 ampere-hour capacity.

Two additional batteries of the 400-ampere size will probably be installed in the near future.

In the center of the basement, as can be seen in Fig. 9, is located the heating and ventilating plant, the system employed being the forced draft, double-duct system with thermostatic dampers to control the proportion of hot and tempered air in each room so as to secure constant temperature, in cool weather; in hot weather the temperature of the laboratory may be controlled by means of the brine coils. In Fig. 20 can be seen one of the two large motor-driven blowers which stand in the basement hall at the entrance of the tunnel, one handling the hot air and the other the tempered air. The second may receive cooled air (in hot weather) from the cooling chamber, which contains a large number of brine coils. The hot and tempered air for the physical building passes through ducts in the upper part of the tunnel as shown in Fig. 13, to the basement of the physical building and is there distributed through the flues shown by dotted lines in the floor plans to the various rooms. The air is heated by passing through stacks of steam coils, the steam being principally the exhaust from the engines. The tunnel shown in Fig. 20 is that running over to the physical laboratory building, a complete drawing of which is given in Fig. 13. Beyond the fan in Fig. 20 are a few steps leading down to the entrance into the cooling chamber and immediately beyond is the end wall of the fifty-meter comparator tunnel, of which particulars will be given later.

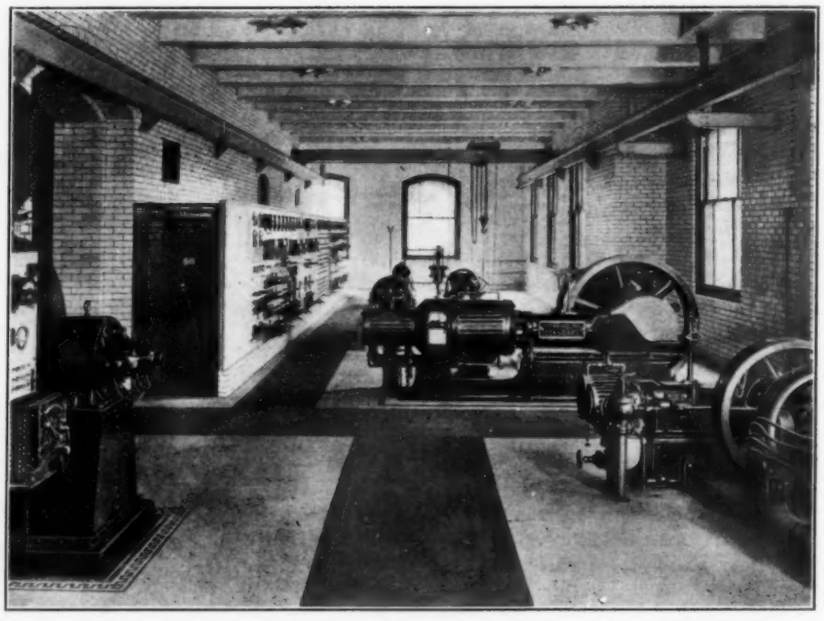


FIG. 18. ENGINE AND DYNAMO ROOM.

THE FIRST FLOOR—THE INSTRUMENT SHOP.

Ascending now to the first floor, (Fig. 10) which is the one on the level with the south entrance shown in Fig. 7, we find

the largest apartment on this floor occupied by the instrument or machine shop, two views of which are given in Figs. 21 and 22. Fig. 21 is a view looking toward the southwest corner; in the foreground can be seen some of the bench precision lathes, and the picture also shows the planer, drill presses, grinders, etc. Some of these machines also appear in Fig. 22, which is a view looking toward the northwest corner, and in addition a milling machine and shaper are shown. It will be seen that this is a shop quite well prepared for the construction of the accurate apparatus required for the work of the Bureau; the machines are all of modern type, and each one is driven by its own electric motor. The object is to construct here such special apparatus as cannot be obtained in the market; the work is done under the eyes of the experts who designed it, and it is considered to be more economical than contracting outside. The men employed to use this equipment are expert mechanicians, and an apprentice system has been established with the aim of providing for future needs. The apprentices are graduates of manual-training and technical high schools, thus assuring the fundamental education necessary in this class of assistants, and it is the intention to develop and promote these young men until they become valuable members in the execution of this portion of the Bureau's work.

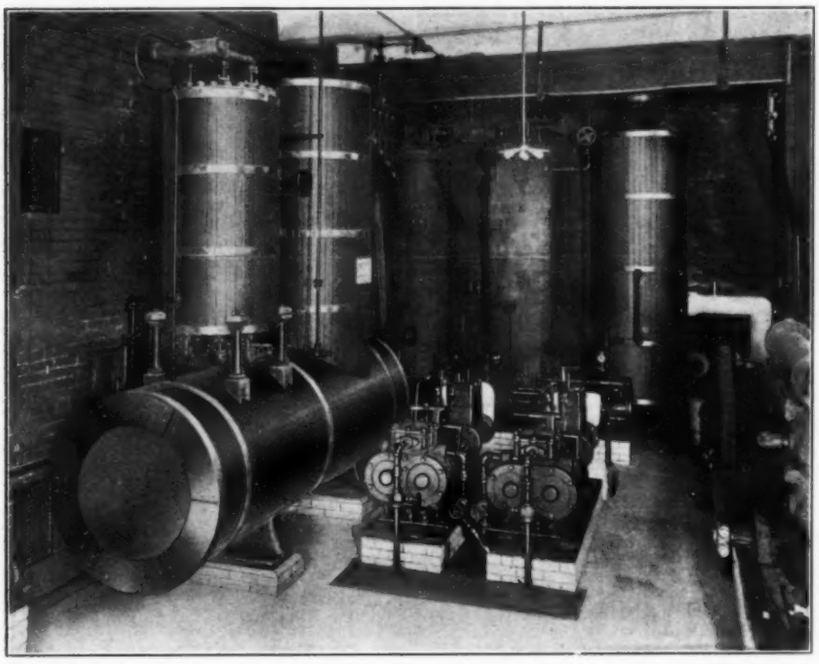


FIG. 19. 30-TON AMMONIA REFRIGERATION PLANT.

The other end of the first floor is occupied by rooms for electrical testing work, involving heavy and alternating currents. The present equipment of this portion is not as yet of a permanent nature, though it will in course of time be fitted up in a manner just as neat and substantial as the other portions of the buildings.

THE SECOND FLOOR.

The section of engineering instruments and materials occupies the largest room on the second floor (Fig. 11), nevertheless the space is nothing like large enough for this department, and as already stated, it is the intention to construct at a future date a building to be devoted to this purpose. Fig. 23 is a view of a portion of this department, showing a Riehlé testing machine, and a gas-meter tester.

Fig. 24 shows another machine in this room, which is a specimen of the work done in the instrument shop and is a machine of unique design. It is for the purpose of testing anemometers. The general scheme of the machine is a long beam sweeping around in a 14-ft. circle with a vertical axis; upon one end of the beam is mounted the anemometer to be tested, one being visible in the illustration. The arm is rotated by the electric motor on the table in the middle, being capable of reaching a speed of 25 miles per hour; with a circle of this diameter one-half the number of revolutions per minute is equal to the speed in miles per hour. The anemometer can be controlled while in motion by means of an electrical circuit, the wires of which can be seen running along the top of the arm. On the table is mounted a rheostat for controlling the speed.

The Bureau is prepared to study and test water-meters not larger than 2 inches, gas-meters, speed-indicators, and pressure-gages. The more important tests of materials which have been made include the test of the tensile strength of the new cable for the elevator in the Washington monument, the cement used in the construction of the new office building for the House of Representatives, and the adhesive power of a large number of mucilages with a view to determine the proper specifications to be used in Government purchases of this article.

FIG. 20. VENTILATING FAN AND SUBWAY LEADING TO PHYSICAL BUILDING. TUNNEL FOR 50-METER COMPARATOR IS ALONGSIDE OF AND TO THE RIGHT OF THIS SUBWAY.

We have had in this journal considerable to say in the past with reference to the subject of interchangeable fire-hose couplings. The Bureau has been conducting an investigation into this matter with a view to the selection of a national standard.

Adjoining the engineering instruments laboratory is the wood-shop, and alongside of that are some rooms devoted to photometry. The photometric work of the Bureau comprises the testing of incandescent lamp standards for candle-power and distribution of light, the commercial testing of lamps as to life, candle-power and efficiency for various departments of the Government, and the study of special problems in photometry. This department is equipped with several photometers of various types.

At the west end of the building is the department of magnetism. The work in this line has not been developed so far as the work of the other electrical sections. A considerable number of instruments for testing the permeability and hysteresis of specimens of iron have been secured and comparisons made by testing the same sample with different apparatus.

(To be concluded next week.)

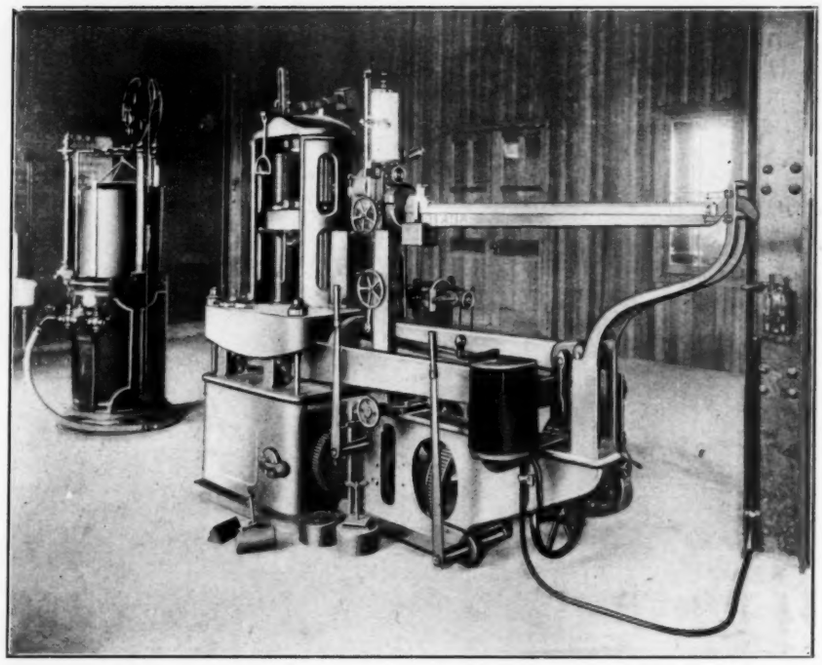


FIG. 23. RIEHLE TESTING MACHINE, AND GAS METER TESTER.

Legal Notes.

BY E. P. BUFFET.

SUIT FOR CONSEQUENTIAL DAMAGES UNDER WARRANTY.

When a defect in a machine causes its purchaser some injury which is clearly due to that effect, yet not as a proximate, or direct, result, but as a consequential, or indirect one, it is sometimes a delicate problem of law to determine whether damages may be recovered under a warranty on the machine. A case involving this question was lately decided by the New York Court of Appeals by a divided bench. On the trial of the case the

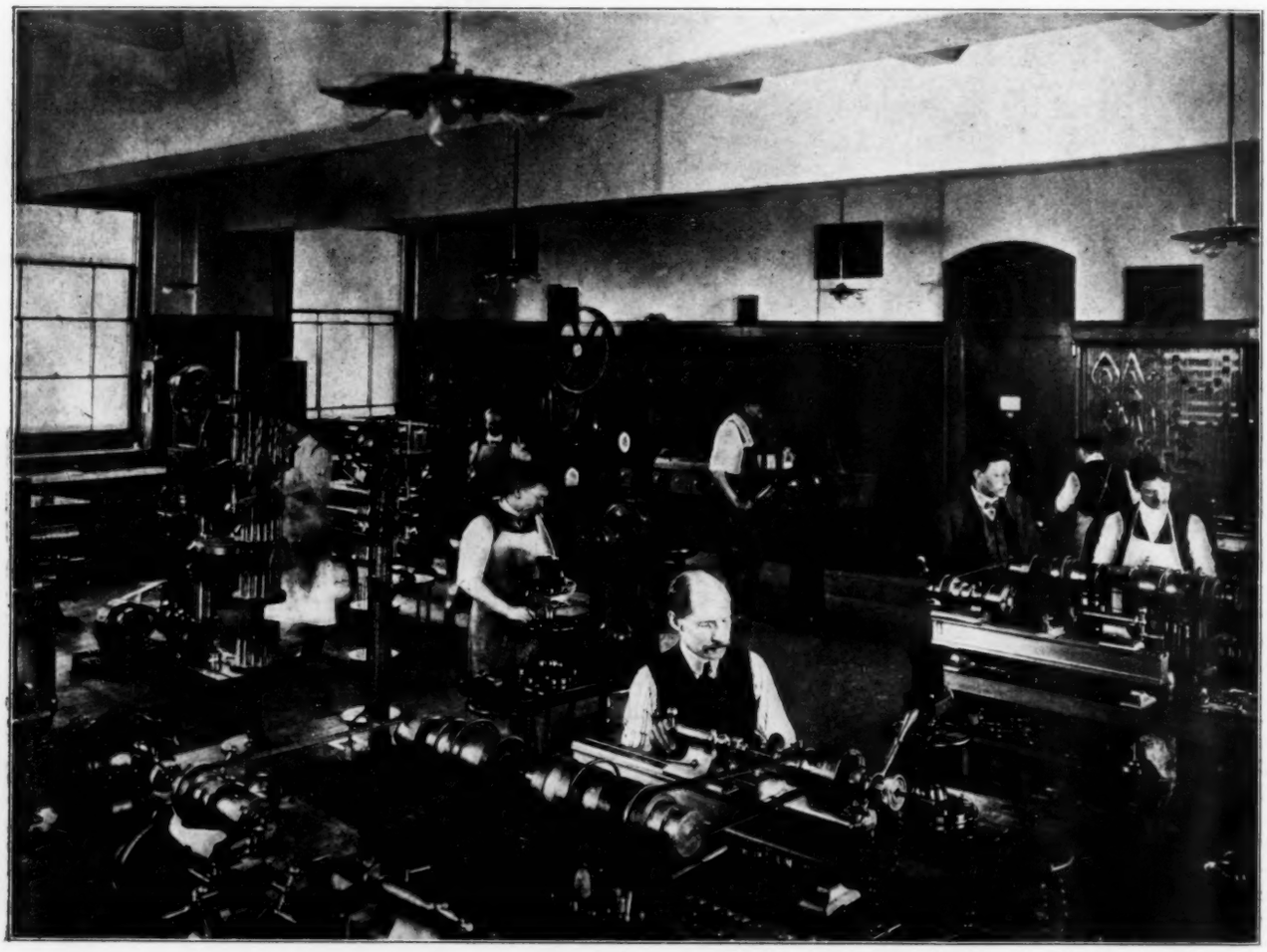


FIG. 21. INSTRUMENT SHOP, LOOKING TOWARD SOUTHWEST CORNER.

counsel for B., the plaintiff, offered the following statement: That the M. Company, the defendant, had sold B. and his brother a corn husker and shredder with this warranty: "It is distinctly understood that the above-mentioned machine is purchased subject to the following warranty and no other: M. Company warrants this machine to do good work, to be well made, of good materials, and to be durable if used with proper care," etc. The machine was provided with a "safety lever" to be employed for throwing the snapping rollers out of gear and stopping them when they became clogged and needed to be cleaned. One day, when B. was doing this, they started up again suddenly and injured his hand. This was claimed to be because the gearing had broken and a bolt slipped out of place, becoming wedged in the gearing so as to render the safety lever ineffective.

The M. Company moved for dismissal of the complaint partly on the ground that, were the facts as stated by B.'s counsel true, they failed to show a basis for recovery, B. not being entitled to recover damages for "personal injuries growing out of a defect of the machine." The motion for dismissal was granted; it has been affirmed by the Appellate Division (before which the case had already come from a former trial), and now by the Court of Appeals. Judge Gray, delivering the prevailing opinion, discusses the effect of different kinds of warranty. He approves the rule that the breach of a general warranty, whether express or implied, does not commonly give rise to recovery for other than the primary injury by the breach. Thus damages for defective goods, for example in the case of certain saws which were warranted to be "of a good quality," are measured by the difference between their actual value and what it would have been had the warranty been true. To be sure there are some conditions under which (even by a general warranty, it would appear) recovery for resulting personal injuries may be allowed, because they are the probable, almost certain consequences, of the inherently dangerous nature of the article, such as a gun, boiler or poisonous article of food. Or a distinction may arise in cases where there is fraudulent concealment, which there does not appear to be here. As to the warranty in the present case he remarks: "It was not otherwise special in its nature than as to fitness for the work, and the vendees had no right to rely upon it, as an assurance against damage, beyond what might necessarily be expected to flow from its untruth."

On the other hand, Judge Bartlett, dissenting in the minority, remarks: "When the manufacturers of this machine warranted it to be among other things, 'Well made', of 'good materials' and 'durable,' they certainly, in view of the fact that this machine was designed for a single purpose only, must be held to have war-

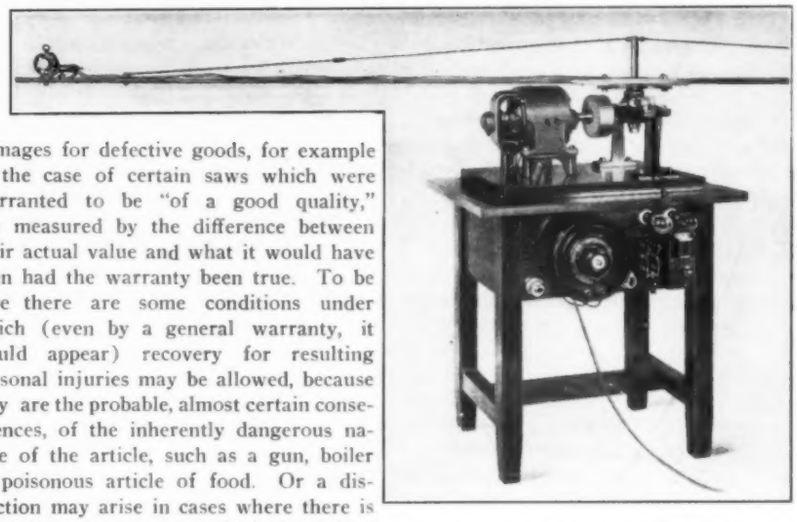


FIG. 24. ANEMOMETER TESTING MACHINE.

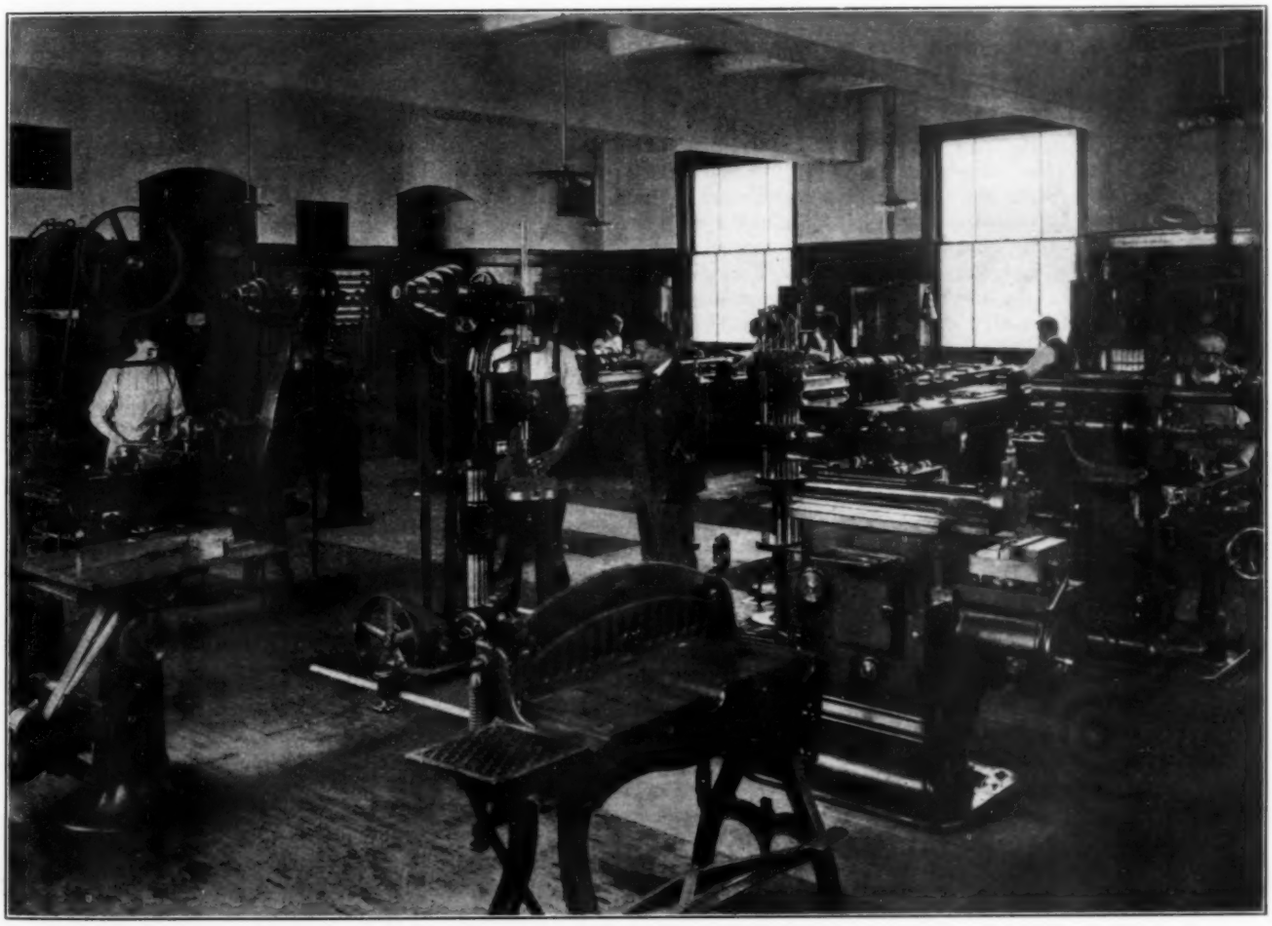


FIG. 22. INSTRUMENT SHOP, LOOKING TOWARD NORTHWEST CORNER.

ranted that the safety lever, designed to arrest the motion of a portion of the machinery to enable the clogged rollers to be cleared by the hand of the operator, would so act as to enable the work to be safely done." He cites as analogous an English case, where damages were allowed for a personal injury due to the breaking of a chain. He thinks that a general warranty should be extended to cover this case.

It is to be observed that whereas, in the case under review, the machine was built by the seller, there are differences in the laws of warranty where the vendor is not the manufacturer, which would require a separate discussion.

76 N. E. Rep., 611.

Visiting Industrial Establishments in Europe and America.

BY P. I. L. GRIM.

The ethics of engineering and machine shops as applied to visitors have three different standards—the Continental, the English and the American. They have their authority in the general custom, and in contrasting them I shall draw upon my individual experience. If it be true that that experience is not general, and does not embrace all divisions of factory and shop life, it is at least representative. My errands were not selfish, nor were they dictated by personal curiosity. Nor were they intrusively made only when they served a mutual interest. They embrace the ship-building plants along the Clyde, Lord Armstrong gun works at Newcastle-on-Tyne, Mather & Platt, engineers of Salford, Manchester, the ship-building yards at Barrow-on-Furness and of Belfast, the Maxim and Nordenfeldt gun factories at Erith, the Government yards at Woolwich, Chatham and Portsmouth and the arsenals at Enfield in England. In Germany and Italy the Krupp shops, in France the Government ship-yards at Toulon, Brest and Cherbourg, the silk mills at Lyons and the great forges at La Creusot, owned by Schneider & Co., the various industrial plants at Barcelona in Spain and many shops and ship-yards in this country and elsewhere.

Roughly stated, the Continental shops admit those visitors only who have official rights; the English shops the official visitors and those properly armed with introductions, while American shops admit anybody, and occasionally nobody. Of course there are exceptions to these rules which are empirically stated. There are shops in England and times when no introduction will serve to secure admission.

When the Armstrong works were building the Chilian battleship "Esmerelda," no introduction would serve to gain admittance to the yard. Nor was any official visé on an introduction of any more value. The employees, particularly the naval architects and inspectors who had a general knowledge of the construction of the ship, were pledged to secrecy, and even the workmen were warned to say nothing about her.

She was in some respects an experiment, and the naval officers attached to the different legations in London were on the *qui vive* to learn all they could about her in advance. The Germans alone secured by bribery an unrevised copy of her plans, and the draftsman who furnished them was subsequently arrested. The German Government interfered diplomatically to protect him, and it subsequently leaked out that he was employed in the civil service of the Prussian authorities, to which country he presently returned. As the English Government was also interested in learning all that was possible about the vessel, it was not very earnest in his prosecution.

Of course in Government yards abroad the rule of secrecy is maintained so far as possible. An officer in the English navy who recently escorted an American naval officer over the frame, as it at the moment existed, of the new battleship "Dreadnought," was court-martialed and dismissed. Notwithstanding this jealousy with regard to information, there is little if any public work done anywhere of which the intelligence departments of the different nations do not secure accurate, early and definite information, particularly if it concerns offensive plans. Nor are they indifferent to schemes of defense. Although the engineer corps of the United States army professes to believe that its system of mines protecting, for example, New York harbor and its approaches is a profound secret, they are known in detail to at least four powers in Europe—England, France, Germany and Italy. On the other hand, this country is fairly informed as to similar precautions abroad. For what other purpose are military and naval attachés associated with embassies? They are accepted *persona grata* by the powers to whom they are accredited, and they are there for no other reason than to get military and naval information.

Of course with this recognized official character it is practically impossible to keep them from the knowledge of what is going forward in private or corporate shops entrusted with Government contracts. In effect there is then an organized and effective system of obtaining intelligence which, if secretly transmitted to the various Governments, destroys in fact the aims of secrecy. It is true that this knowledge is limited to a particular group; but what Governments may acquire, manufacturing and mercantile interests may also attain, and as a matter of fact they do so whenever the object sought is sufficiently important to justify the effort.

Experimental work can of course be maintained a secret, but this is apart from the subject. The chief cause which induces shops to deny visitors is that knowledge of their methods may become general, to their disadvantage; but there are other reasons; among them, and the most obvious, is the bother and worry of having visitors about. Ordinarily a manufacturer takes pleasure in showing a visitor his shops if they be intelligent and have something more than elementary knowledge that may prove useful to both; but the mere curiosity-seekers are a nuisance, and they form the great majority of applicants for admission.

However, the general Continental rule is not to admit anyone to the works whose errand is not distinctively official. Persons who come on business have common meeting ground with heads of departments in a room set aside for that purpose. Perhaps an individual experience at Schneider & Co.'s great works at Le Creusot in France will illustrate the general custom. We were equipped first with a letter of introduction from the English Ambassador to the Minister of Commerce and Industry, at that time M. Paul Lelombre. He inquired the nature of our proposed visit and approving of it passed us on to the bureau officer who "authenticated" our visits to the works. It was explained to us that the Schneiders, while they do a great deal of Government work, are strictly a private corporation and that the question of final admission would remain with the administration of the works. There was a good deal of red tape and ceremony, but after two days' delay the "authentication" cards arrived and we took the train for Dijon at the Gare Lyons and transferred to Le Creusot.

On our arrival there we presented our cards to a clerk who presided in a handsomely furnished reception room, and with them the authentication cards from the Minister of Industry. He begged us to be seated and offered us the weekly and daily papers while he submitted the cards. In a short time he returned and politely asked us to follow him. We found ourselves in the private office whose occupants were a gentleman at a desk and a stenographer. The latter immediately left the room and the former rose and bowed us into seats. He then asked the nature and cause of our errand, which we stated in detail. He at once assented to our request and said he was *desole* not at the moment to be able to accompany us, but if we would entrust ourselves for the time to an officer of the administration he would join us as soon as he had disposed of some exigent matters. He then summoned a young man, a linguist, who not only spoke all languages with grace and facility but had an intimate knowledge of the whole works. They were making some nickel steel in a laboratory and we were interested in the process. Our guide had a thorough technical knowledge of the subject and we ventured to suggest that he had given the matter special attention.

"No," he replied, "I am one of the commissionaires or guides. It is necessary for me to be informed on the subjects that may interest guests of the administration."

"Do you have many?" he was asked.

"No sir, but those who do come have much to ask. Perhaps some every week, and then a week there are none. At such times I reply to letters asking for information."

We remained two days at Le Creusot. Sometimes the commissionaire was in attendance, at others the assistant superintendent, whom we first saw. No pains were spared not was any courtesy lacking. The distance to our hotel from the entrance of the works was considerable, over a mile. A cab was called for us invariably on leaving, and this kindness was entirely voluntarily undertaken, and we left Le Creusot with the most pleasant recollections.

At the hotel, however, we met a group of English tourists, including an ironmaster from Durham. They were armed with a consular introduction and did not gain admission to the works at all.

At Essen, Germany, the works of Herr Krupp were visited with no particular red tape. We applied in the morning, were admitted before noon and were most civilly treated. At the same firm's works at Livorno in Italy the authentication of the Minister of Public Works, Signor La Cava, was necessary as it was also required at Spezia, which is the chief naval and military port of the Kingdom.

To all of these places and at Cherbourg and Brest I was accompanied by an artist and our errand was to prepare for an English magazine a general and descriptive article on war factories. The artist was not permitted to take photographs, nor to make measurements, but the photographs, liberally taken by the managements themselves, were freely at our disposal and proved entirely adequate. In Barcelona, Spain, the artist was not admitted at all.

As the stories were written for the information of the general public and were in no sense technical, no objection was made to our inquiries. On the contrary we were freely supplied with information.

In Great Britain the visitor to engineering works has only to be armed with a good introduction. Such an one we presented to the great Hadfield Steel Foundry Company at Sheffield—and to Mather & Platt, machinery makers of Salford.

Both of these great plants are the objective points of an army of sight seers at all seasons of the year. Mather & Platt receive them almost daily and the Hadfield Company quite as frequently, but the letters of introduction are always regarded courteously and their bearers never have occasion to complain of their reception. But one might as well apply, without credentials, to be served in a private club as to seek admission there, if unknown, without a letter of introduction. One's own statement of his importance backed by his card would not be regarded at all.

It is the conventional spirit of English social and business life that demands this. It pervades all grades of business and society, and in accord with it everything moves, but nowhere more exactly than in manufacturing and commercial levels.

The more formal way of presenting a letter of introduction is the favorite method. By sending it in the post with an accompanying note, a reply is at once elicited making an appointment for a personal meeting. After that is secured the way is fully opened and nothing in the way of welcome will be lacking. Nor is there reserve of knowledge. It is all open and the law of hospitality is safely, or at least faithfully depended upon to protect the host.

On arrival at one of these plants the visitor is received at once. An appointment is an appointment in Great Britain and is carefully regarded as to time by host as well as guests.

The ship-building yards have their occasions for receiving guests as a rule. On the occasion of a launch or a trial, the business of the day is combined with social functions and the whole business is cleaned up at once. A visitor can secure admission, however, at almost any time. The best way for an American tourist who wishes to visit the ship-yards and engineering works on the Clyde is to apply to the United States consul for a card, which will be readily furnished, and will prove efficient almost anywhere. The same is true of the works in any town in the British Islands, at Belfast, Newcastle, Sheffield, Birmingham, or Nottingham. In towns where there is no consulate there will be found a consular agent who is competent, and usually willing to oblige Americans in such matters.

In contrast to this regular and orderly system, the haphazard way that prevails in the United States might be commented upon adversely, if it were not that it too has its advantages. There are no punctillia to be observed as a rule, and merely presenting oneself at the works will be all that is ordinarily required. Then if the visitor is prepared to meet some degree of inattention and brusqueness nothing more disappointing will befall him.

In the ordnance yards at Washington, the door is open. Anyone may walk through them in all their departments except where shells are being loaded and explosives are kept. There is one rule which, if he infringe, will be promptly called to his notice. He must not enter into conversation with the operatives during working hours. The same order is enforced with more or less strictness in all United States Government yards and shops.

When Cramps were building, some years ago, ships for the Russian service, and subsequently the battleship "Kasagi" for the Japanese Government, the rule of exclusion was pretty sternly enforced. But generally speaking there are no hard restrictions upon visitors at any of the great ship-yards. The Union Iron Works at San Francisco, The Fore River ship-yards near Boston, the Bath Iron Works, the Newport News Ship Building Company, the New York Ship Building Company, at Camden, and others receive visitors with almost open doors, although they may take no particular pains to make even well accredited guests feel at home.

In some of the great corporation plants this fact is quite observable. Not long ago I visited the works of one of the great trusts. Admission to a dirty unfurnished office was had, and through a ticket hole a clerk was summoned by calling to him. At first he did not respond, being engaged in lighting the stump of a cigar. Then he indolently walked to the window and remarking that we seemed "in a hell of a hurry," asked our business. A card of admission from the president of the company was passed in which he scanned, then walked away to an inner office. Presently he reappeared and beckoned with his hand. Not being accustomed to being called in that way we turned our backs, when he came to the door and said abruptly, "go over there," and left us to find local authority. After that there was no trouble. The manager wrote us new cards and told us to go where we liked and remain so long as we chose. If we wanted to know anything further than we saw and learned in the plant, to come back to him and he'd try to find time to tell us about it, but he was very busy. It was a big plant, and he was busy unquestionably, and he was not troubled.

The General Electric Works at Schenectady receives visitors on the English plan, and their attention and courtesy is even an improvement on what prevails generally in Great Britain; so does the Baldwin Locomotive Works in Philadelphia, and many others. But after all the American is in too great a hurry to discriminate, and too careless. Anybody almost, can see him at almost any time. If the visitor catches his interest for the moment he will be entertained and instructed. If not he will find himself treated with scant courtesy.

In this hustling age and particularly in the States the system which puts administrative and executive officers of corporations and works at the call of all classes of visitors, who come for all purposes, even the most unimportant, is carried to the extreme limit. Gradually the better and more formal conventions of business approach are being adopted. It will be to the advantage of everyone when they become the general practice.

The railroads of the United States have in use 620,000,000 cross ties.

The Design of Bending Rolls.

BY A. L. DE LEEUW.

Though bending rolls may be called rough machinery, that is, machinery which does not call for the last 1/100 inch in order to be accurate, and though they do not call for the ingenuity displayed in automatic screw machines and the like, the designer will find that he has quite a problem on his hands when he has to lay out a set of bending rolls of given capacity. It does not happen very often that he is called upon to make his designs new from the ground up. Generally, there is something to go by, and his work is limited to such changes as adapt an existing machine to the new conditions. However, it happens now and then that he is thrown on his own resources and it is then that he finds out that the design of a set of bending rolls is not quite so easy as it looks.

The power required both for bending and for rolling is the stumbling block. All of the difficulties vanish more or less, as soon as this one thing is settled. I have been asked a number of times to give some rules for determining the power required to roll a plate of given width and thickness; and, though I cannot give any rules which may be applied with the eyes shut, still I think it may be of interest to some of your readers to know my procedure. The formulas used have always given good results; and, what is more, I have made it a point to apply them to a great number of existing rolls, in order to check them. The result was that the formulas proved to correspond very closely to the data of a great number of successful rolls. I feel, therefore, that they are entitled to "respectful consideration," if for no other reason than that they "get there."

The rolls to be considered here are of the pyramid type; that is, with one top and two bottom rolls. The top roll is called the bending roll, while the bottom rolls are called feed rolls. We will first assume that the proper sizes of the rolls have been found, and that the question is to find the power required for bending and rolling. The radius of the top roll is called r_2 and of the bottom roll r_1, as in Fig. 1. The radius to which the plate is to be bent is R; the distance between the centers of the bottom rolls is L. The thickness of the plate is d and the width of the plate is b.

We will first find the pressure required to bend the plate. The pressure is merely the pressure needed to give the plate permanent set. The fiber stress in the plate must therefore pass the elastic limit. For the rest, the problem is simply one of determining the fiber stress in a beam, supported loosely on two points and loaded in the center. The distance between the supports is called x. This distance varies with the curvature of the plate, and is a minimum when the plate has been bent as far as it has to go. It follows that the required pressure is a minimum when the bending begins, and that it gradually increases. The distance between supports being L at the moment when the bending begins, the pressure P must be such that

$$\tfrac{1}{4} PL = \tfrac{1}{6} b d^2 \times S$$

from which follows that

$$S = \frac{6 PL}{4 b d^2} \text{ and } P = \tfrac{1}{6} \frac{b d^2 \times S}{L}$$

which is the elastic limit in this case, and which should be taken at about 45,000 pounds for ordinary boiler plate. It will be remarked that this value of S is more than the elastic limit; and so it is, but it seems that it is not safe to take a lower value in this case, perhaps because the effect of the scale is quite marked, the plate being relatively thin, or perhaps because of some other reason which I am not prepared to give. The first hypothesis is carried out by the fact that it requires relatively less pressure to bend a thick plate than a thin one. It is sometimes held that this pressure is so high, because the speed of bending the plate is so much greater than when S is determined by the testing machine. However, speeds of 1 inch per minute cannot be considered as very fast, and they still show the same high value of S.

In the above calculations L was taken as the distance between the supports. Though this is true at the beginning of the bending, it is not true at the moment when the bending pressure is a maximum. At that moment the distance between supports is x. Fig. 1 shows clearly that

$$(R + d) : (R + r_1 + d) = x : L$$

from which

$$x = \frac{(R + d) L}{R + r_1 + d} \text{ or } x = \frac{R L}{R + r_1} \text{ (by neglecting } d, \text{ which is small).}$$

Taking L in the equation for P, and replacing it by this value for x, we find that

$$P = \tfrac{1}{6} \frac{(b d^2 \times S)(R + r_1 + d)}{(R + d) L}$$

or by neglecting d,

$$P = \tfrac{1}{6} \frac{b d^2 \times S}{L} \times \frac{R + r_1}{R}$$

The depth to which the plate is bent can be found by considering $\frac{1}{2} x$ as the geometric mean between it and $2R$ (the diameter to which the plate is being bent). This is not quite correct, as $2R - D$ should be taken instead of $2R$; however, D is always small as compared with $2R$, and the error is therefore small. The resulting formula is so much easier to handle, that I feel justified in making this error.

We have then

$$D : \tfrac{1}{2} x = \tfrac{1}{2} x : 2R \text{; or, } D = \tfrac{1}{8} \frac{x^2}{R}$$

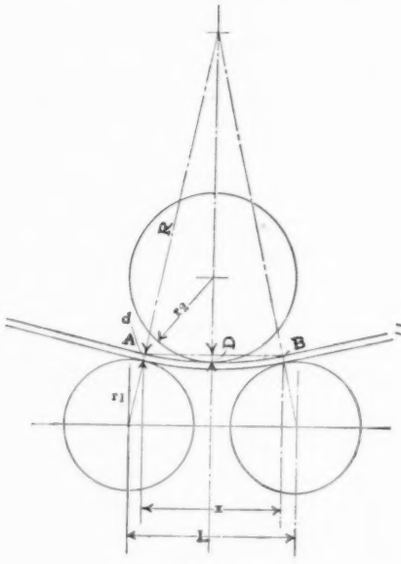


FIG. 1

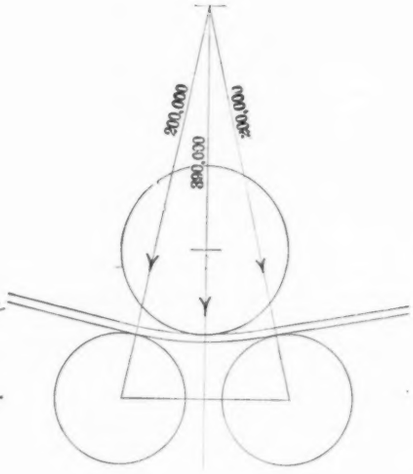


FIG. 2

THE DESIGN OF BENDING ROLLS.

If the pressure were a constant quantity, the work done in bending the plate could be expressed by PD. However, this pressure is not constant; and therefore, the product PD is not exactly the correct expression of the work done. The exact formula could be found by integration; but the resulting formula would be very unhandy, and, after all, would not be of any greater practical value than the simpler formula we get by taking the pressure as constant. The reason why we take the pressure at its maximum is that we want to be sure that we get enough. The fact that we get a little more than is necessary does not do any particular harm.

Taking then PD for the work, and inserting the values found above for P and D we obtain

$$PD = \tfrac{1}{6} \frac{b d^2 \times S}{L} \times \frac{R + r_1}{R} \times \tfrac{1}{8} \frac{x^2}{R}$$

and substituting the value found for x we obtain

$$PD = \tfrac{1}{6}\frac{bd^2 \times S}{L} \times \frac{R+r_1}{R} \times \frac{6R^2L^2}{(R+r_1)^2} \times \frac{1}{8R} = \tfrac{1}{12}\frac{bd^2SL}{R+r_1}$$

Both lower rolls drive. The result of this driving is, that the plate assumes the shape of a continuous circle instead of a part of a circle with straight ends. In other words, the driving or feed rolls continue the work of the bending roll. We might bend the plate to a continuous circle without driving the feed rolls at all, and do it entirely with the bending roll; using the feed rolls merely for supports. In order to do so, we would bend the plate, then elevate the bending roll, move the plate over a certain distance and bring the bending roll down again; and keep up this cycle of operations until the entire plate is bent. Of course, this would be a tedious operation; and, besides, the plate would not be bent to a perfect circle. I simply mention this way of bending the plate, because it shows an easy way of computing the work done in driving the feed rolls. It does not matter, of course, in what way we reach our result; the amount of mechanical work spent upon the operation will be the same; at least, if we neglect the friction. If the plate is in the condition shown in Fig. 1, that is, partly bent and partly straight, and if we continue the operation of bending the plate by driving the feed rolls, then the work done when another length of plate equal to AB is bent will be equal to the work done in bending the first portion of the plate. This amount of work we found to be

$$PD = \tfrac{1}{12}\frac{bd^2SL}{R+r_1}$$

Work done, equals the force times the distance traveled by the force, and in the direction of the force. The distance traveled by the force is the arc of which x is the chord. In this case arc and chord are so nearly equal in length that it will be allowable to use the chord instead of the arc in our computations.

Driving force equals work done in bending, divided by chord x. That is

$$F = \frac{PD}{x} = \tfrac{1}{12}\frac{bd^2SL}{R+r_1} \div \frac{RL}{R+r_1} = \tfrac{1}{12}\frac{bd^2S}{R}$$

A PRACTICAL EXAMPLE.

We will take as example the bending of a plate 24 feet wide, 1 inch thick, and which should be bent in one pass to a circle with a radius of 10 feet. We will assume the ultimate strength of the plate to be 60,000 pounds per square inch. A safe figure for S will then be 45,000 pounds. We find that the pressure of the top roll on the plate should be 390,000 pounds, with the following data for the rolls:

Diameter of upper roll, 24 inches.

Diameter of lower rolls, 20 inches.

Distance between centers of lower rolls, 24 inches.

The value for x becomes then 22 inches and the value for D will be practically ½ inch. The work done in bending the plate to this depth is 390,000 × ½, or 195,000 inch-pounds. The combined pull at the circumference of the two lower rolls is 9000 pounds.

At the first glance these figures seem to be entirely too low. Take, for instance, the pull at the circumference of the lower rolls: This was found to be 9000 pounds. As the speed at which such a plate is bent does not ordinarily exceed 10 feet per minute, the driving power required for this set of rolls would be only 9000 × 10, or 90,000 foot-pounds per minute, or not quite 3 horse-power. Anyone knows that this would be only a small portion of the actual amount of power required for a plate of this size. Nevertheless, the figures found are of the greatest importance, as they show us what the required power would be if there were no friction.

We come thus to the second part of our calculations, namely, the determination of the power required to overcome the friction. We will consider in the first place the friction in the journals of the rolls. A fairly good rule, though one which cannot be applied with the eyes shut, is to make the diameter of the journals equal half the diameter of the roll. This rule is good enough for us at the present, as the object of the following calculations is merely to show the effect of friction on the amount of driving power required. We will therefore make the journals of the upper roll 12 inches and those of the lower rolls 10 inches in diameter. These journals are subjected to a very high pressure per square inch, and the lubrication is therefore bad. Besides, bending rolls are generally put in dusty and sometimes in only partly covered places, and the operators are not always the very best and most careful mechanics. Journals and bearings would wear out in a very short time, were it not that the speed of the rolls is very low. In our case, for instance, the speed of the roll is supposed to be only 10 feet per minute, and even this speed is relatively high; for in many cases rolling speeds as low as 3 feet per minute are used. The speed of the journals is even less than this, as the journal is only half as large in diameter as the roll.

Though journals and bearings do not rapidly wear out, thanks to the low speed, nevertheless the conditions for running are bad, as there is metal-to-metal contact; so that it is not safe to figure on a smaller coefficient of friction than 20 per cent. The pressure on the journals is the same as the pressure exerted by the top roll, which we found to be 390,000 pounds. Each of the journals of the top roll is, therefore, subjected to a pressure of 195,000 pounds. The journals travel with a speed of 5 feet per minute, so that the work done to overcome the friction of the two journals of the upper roll is 2 × 5 × 20/100 × 195,000 foot-pounds, or 390,000 foot-pounds.

In order to find the work done in overcoming the friction of the journals of the two lower rolls, it will be necessary to ascertain the amount of pressure on these journals. Fig. 2 shows in diagram the

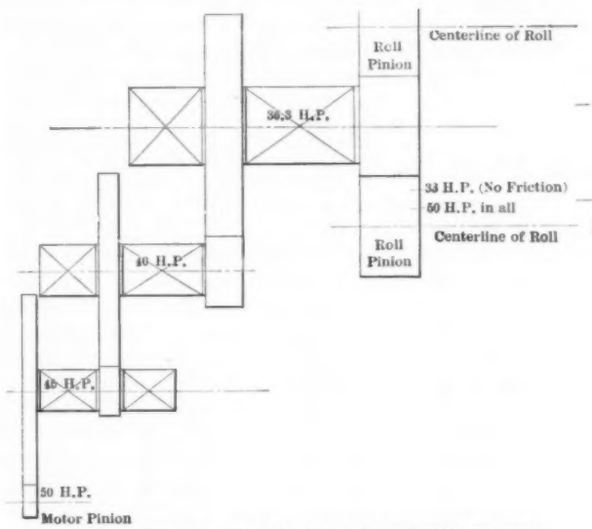


FIG. 3. SKETCH PLAN OF DRIVING GEARING.

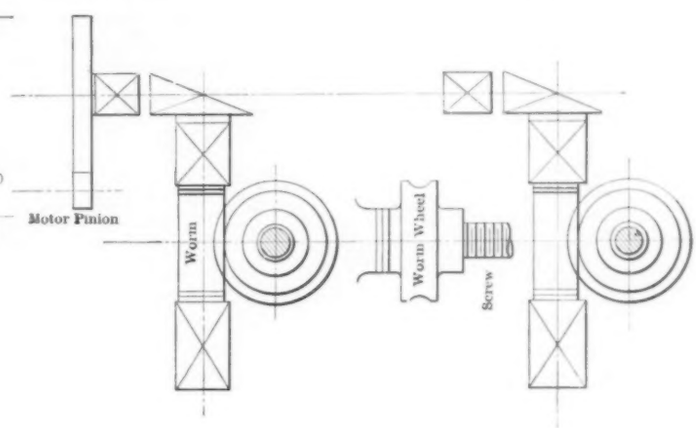


FIG. 4. SKETCH PLAN OF ELEVATING GEARING.

pressures on the lower and upper rolls. The pressure on the upper roll can be considered to be the resultant of the two pressures on the lower rolls, which, it will be easily seen, is about 200,000 pounds. This pressure would have been somewhat more if the radius to which the plate is being bent had been smaller. However, plates of the given size are not likely to be bent to small circles. Should such a thing occur, it would be easy enough to make allowance for it. Half of the 200,000 pounds comes on each journal of each lower roll. These journals travel at a speed of 5 feet per minute. The work done in overcoming the friction of the four lower journals is therefore $2 \times 5 \times 20/100 \times 200{,}000$ foot-pounds. The total work done in overcoming the friction of all the journals is about 24 horse-power, which, added to the 3 horse-power for driving the rolls against the resistance of the plate, makes a total of 27 horse-power.

The co-efficient of friction was assumed to be 20 per cent., and this is sufficient when the rolls are new, or when unusually good care is taken to keep the journals in proper shape; but when scale lodges between journal and bearing, or, when either of the two becomes scored, then this co-efficient would be too low. It is, therefore, safer to start out with not less than 25 per cent. In that case, the amount of work done in overcoming the friction of the journals is 30 horse-power and the total is 33 horse-power. It is now clear that there is no necessity of figuring the pull on the circumference of the rolls to the last pound, as the friction requires several times that amount. It will also be seen why the pressure on the plate should be figured as low as safety will allow; for this pressure appears again in the work done to overcome friction. The power figured so far, does not include the power required for driving the gear train. A fairly good rule is to add 10 per cent. to the power for every shaft with its gears.

Fig. 3 shows a typical arrangement of the gearing of a set of large bending rolls such, for instance, as the one computed here. Following the above rule, we find that the power required in the motor, or engine is 50 horse-power. In case an electric motor is used, we would very likely select a 60 horse-power motor.

POWER REQUIRED FOR ELEVATING.

We will have to assume a certain construction of the elevating machanism in order to compute the power required for bending the plate, as here again the greater part of the power is used in overcoming the friction. It may be remarked here, that the term "elevating" is rather badly chosen, as it is not the elevating of the upper roll which requires the power, but the bringing down of the roll on the plate. However, the term is commonly used, and it is generally better to speak a language which is understood, though not quite correct, than a language which is correct but not understood. The elevating motor (or engine) must be large enough to do the bending when the plate offers the maximum resistance. We will assume that the speed of elevating is 1¼ inches per minute. This speed may not seem to be very high, but it is doubtful whether a higher speed expedites the work, as it would not allow the operator enough time to use his judgment or his templet. Of course, it will be quite easy to correct the figures if one should want a higher elevating speed. As the pressure is 390,000 pounds, and the speed is 1¼ inches per minute, the power required for elevating will be $1\frac{1}{4} \times 390{,}000$ inch-pounds, or 487,500 inch-pounds or about 40,000 foot-pounds per minute.

Fig. 4 shows the arrangement of the elevating mechanism in diagram. The journal boxes of the upper rolls are moved by screws, which, in turn, receive their motion from worm wheels. These worm wheels are at the same time the nuts for the elevating screws. Each worm wheel is driven by a worm, and the worms are driven, in their turn, by bevel gears. The driving bevels are on one shaft, running along the machine. These bevels are really running loose on the shaft, and can be connected to it by means of clutches, but this part of the arrangement is not shown in the diagram, as it does not affect the calculation of the required power. The same amount of power would be required if there were only one screw instead of two, though, of course, the strains on the parts would be twice as great. However, as we are not figuring the strains, we may figure as if there were only one screw doing the work This screw performs 487,500 inch-pounds per minute or 39,000 inch-pounds per revolution of the screw, if we assume that the lead of the screw is 1 inch. The co-efficient of friction of the screw in the nut may be taken as 15 per cent. It is not safe to take less, though of course, there is no absolute certainty about this figure. The pitch diameter of the screw is supposed to be 7 inches. The screw is moved 22 inches against the frictional resistance for every turn. The work done in overcoming the friction in the nut is therefore $22 \times 390{,}000 \times 15/100$ or 1,287,000 inch-pounds per revolution of the screw. The total work done by the nut is the work required for pressing the roll against the plate plus that required to overcome the friction. In our case, this total is 1,676,800 inch-pounds. This work is done by the nut while it rotates, and, while doing so, it has to overcome some friction of the washers. We will suppose that these washers are 15 inches outside diameter, and 7½-inch bore (the outside diameter of the screw). The mean diameter is therefore 11¼ inches and the mean circumference about 35 inches. The co-efficient of friction should be figured not less than 10 per cent., as the pressure per square inch is very large, and the lubrication doubtful. The work done per revolution of the nut, to overcome the friction of the washers is $390{,}000 \times 35 \times 10/100$ or 1,365,000 inch-pounds. This brings the total up to 3,041,800 inch-pounds or about 253,000 foot-pounds.

We will further assume that the worm wheel has 40 teeth, 2-inch pitch, and that the worm is 7½ inches outside diameter. This makes the pitch diameter of the worm 6.3 inches, and the pitch circumference 19.8 inches. The worm makes 40 turns for one turn of the worm wheel. The pressure on the teeth of the worm wheel is such that 253,000 foot-pounds of work are performed during one revolution of the worm wheel. The pitch circumference of this wheel is 80 inches or 6 2/3 feet so that the pressure on the teeth is 38,000 pounds. Recapitulating,

Pressure between worm and worm wheel is 38,000 pounds.

Co-efficient of friction is 15 per cent.

Number of inches traveled by a point at the pitch diameter of the worm is 19.8 inches.

Therefore, work done to overcome friction, during one revolution of the worm is $38{,}000 \times 15/100 \times 19.8$ or 112,860 inch-pounds.

The worm forces itself endwise with a pressure equal to the pressure on the teeth of the worm wheel, and this end pressure is taken up by some washers on the worm shaft. Assuming these washers to have a bore of 3½ inches and to be 7½ inches outside diameter, then their mean diameter will be 5½ inches, and their mean circumference 17.2 inches. Figuring again on a co-efficient of friction of 10 per cent., we find that the work done in overcoming the friction of the washers of the worm is $38{,}000 \times 10/100 \times 17.2$ or 65,360 inch-pounds. The total of the work done in overcoming the friction for one revolution of the worm is, therefore, 178,220 inch-pounds. As there are 40 revolutions of the worm per revolution of the worm wheel and screw, the work done in overcoming the friction between the worm, worm wheel and washers, for one inch travel of the upper roll, is $40 \times 178{,}220$ inch-pounds $= 7{,}128{,}800$ inch-pounds $=$ 594,000 foot-pounds.

The total of the work done at the worm, and for one inch roll travel, is, therefore, $253{,}000 + 594{,}000 = 847{,}000$ foot-pounds The total work done per minute is therefore $1\frac{1}{4} \times 847{,}000$ foot-pounds $= 1{,}059{,}000$ foot-pounds or 32 horse-power.

Allowing again 10 per cent. for friction of each shaft with its gears, the arrangement as shown in the diagram would require 38.7 horse-power. Call this 40 horse-power.

There is, perhaps, no machine so inefficient as a set of bending rolls, so far as consumption of power is concerned. The fact that extremely heavy pressures and low speeds are used, is the cause of this, and at the same time makes it ex-

tremely difficult to remedy the evil. Roller bearings have been used on small rolls, and with surprising results. But as roller bearings are constructed at the present, they are not applicable to the larger sizes of bending rolls.

The Printing Press in the Drawing Office.

EDITORIAL CORRESPONDENCE.

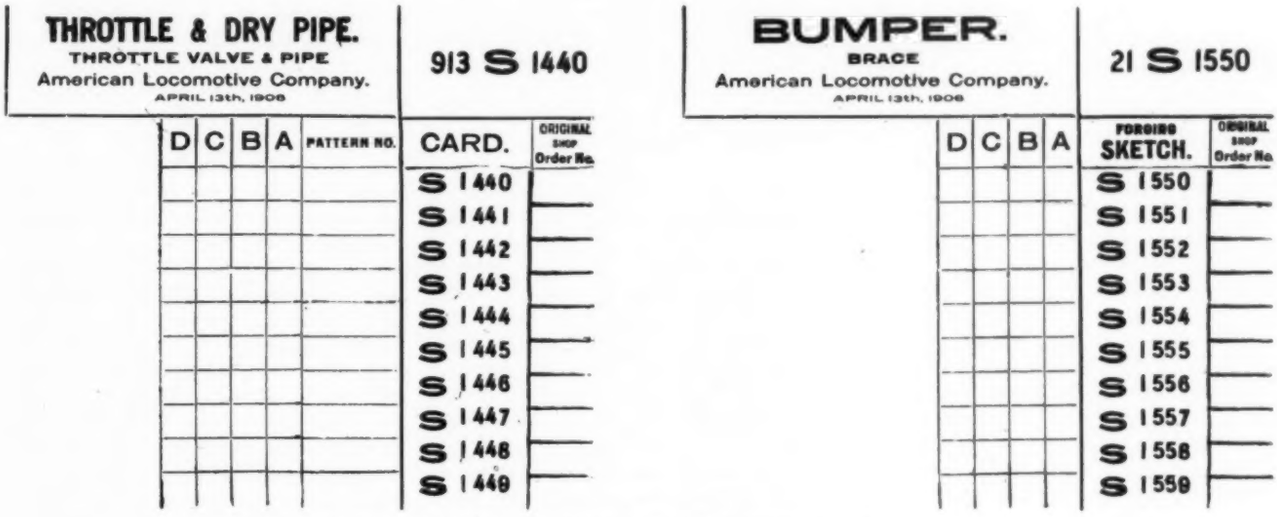
At various times contributors to the AMERICAN MACHINIST have referred to the use of a printing press for printing titles on drawings and tracings. The method has been in use for some time at the Schenectady Locomotive works, to the entire exclusion of hand-printed titles, and is found to lead to a decided saving in cost, especially as the printing is done by boys instead of highly paid draftsmen.

The printing office is supplied with a large number of electrotypes from which the forms are made up surprisingly quickly and with very little setting of individual type. Two facsimile reproductions of titles are given herewith, which show how little typesetting is required. Of the titles proper, the only individual type used are those for the dates, the other lines being in stock as complete electrotypes. Similarly the table headed D. C. B. A. is a complete electrotype. This table is used for changing dimensions without retracing. When a part is to be used as already drawn, but with some dimensions changed, the figures are blotted out and a reference letter substituted, the old and new dimensions being entered in the table, the letter and number in the same line serving to index and identify each change. These tabulated figures in the case of complex parts often contain many more columns, and electrotypes are supplied containing various numbers of columns up to the entire alphabet so that it is only necessary to select a suitable table.

The press used is a simple hand machine, very much like the small toy presses which are so widely sold, but of course of suitable size and strength. For use on tracing cloth a special ink made for the purpose by the Keloe Ink Company is used, quick drying being secured by dusting the cloth with fuller's earth before printing.

The tracings are sent to the printing office with a memorandum slip attached on which the draftsman has written the title. This memorandum need not be and is not complete, the memorandum for the letter-headed table giving the range of letters required only, while the numbers under *Card* are fully indicated by the inscription above, since the numbers below always begin with the one above and the range is always 10. The draftsman's work in making his memorandum is thus extremely simple.

At first sight the setting up and printing of a single impression on a printing press would seem to be a somewhat left-handed way to save time, but first impressions are often wrong, and they prove to be so in this case. F. A. H.



EXAMPLES OF DRAWING TITLES MADE ON A PRINTING PRESS.

It is stated that the battleship "Connecticut," which is now nearing completion at the Brooklyn Navy Yard, will cost the Government about $300,000 more than the "Louisiana," built by the Newport News Shipbuilding Company. This amounts to about 7 per cent. in excess of the cost of the ship built in a private yard. This is considered a very good showing indeed. The place where the "Connecticut" was laid down had to be thoroughly piled before she was begun; a large traveling crane was erected; new tools were bought and installed; the Government employees receive 10 per cent. more wages than do those in private yards; the mechanics work 8 hours in the Government yard, while those in the private yards work 10. On the other hand, the yard at Newport News was thoroughly equipped when the contract was awarded.

Echoes from the Oil Country—Use and Abuse of Tools—A Battered Monkey Wrench.

A party of gentlemen were passing through a shop. They were young, active men who helped to make things go in various ways where they belonged. They were connected with mechanical interests in different ways, but all held positions of responsibility. If there was a man in the lot who had "come up through the mill" he could not be picked out by his looks. A man from the office was showing them through.

A dilapidated monkey wrench lying on the bench attracted the attention of one of them. "I see that we are not the only people who have men who should be shoveling dirt instead of working in a machine shop," he remarked, as he stopped and pointed to the wrench. "From the looks of that it has been used for almost everything besides the use it was made for."

It did look as if it had seen service. The head was bruised, and the jaws were sprung. One side of the wood of the handle was missing, and all parts of it were covered with dents and scars. It was a 15-inch Coes knife-handle wrench, but its beauty had departed.

"It is hard on the designer who has his work go into the hands of men who give it that kind of usage," remarked one who might have been a draftsman, judging from his views.

"The cheapest thing made will do some fellows as well as the most expensive," and if the speaker was not a purchasing agent, he had a natural bent that way.

"With the abundant means at hand for the acquiring of knowledge it would seem as though it were not necessary to tell any man that there is only one proper way to pull on a wrench. It will stand much more that way, as has been demonstrated time and again." The youthful appearance of the speaker showed that he had

not as yet had time to forget what he had learned in college, nor practice enough to have it crowded out.

"Isn't it strange how some men will go out of their way to do the wrong thing. There is no doubt about this wrench having been used as a hammer a great many times, and under no condition would it be as efficient or as convenient to use as a hammer would have been. It is curious, too, but sometimes a wrench like that will belong to a good man, or at least to a man that the foreman stands up for as being a good man. One has to take a foreman's judgment of a man to a great extent, even if it does not always tally in all particulars with your own." Perhaps this man's father owned a machine shop. He seemed to have some experience.

They passed on, and a man who had come up in the rear, and had overheard most of the talk, picked up the wrench. He turned it over in his hand, while a curious smile passed over his face. "I wonder how much the abuse on that wrench has been worth to this company?" he muttered to himself. In the intervals of his work he kept thinking the matter over since the time that the wrench had been first put into his hands by the foreman. It was new then, and might have cost the company a dollar, but more likely less than more. It was still a new wrench when the foreman came to him. "John, take your wrench and go to the blacksmith shop. Some of the overhead rigging has come loose and they are stopped. Get them going again as soon as you can."

In a few minutes John was up overhead in the blacksmith shop where it was hot and dusty and greasy. He found that some stringers that held a countershaft had shifted. He pried them back to place and started to tighten the nuts on the bolts that held them. The bolts had worked out as the nuts worked off, and the nuts were on the bottom side. A man had to hang on as best he could with one hand, lean over and feel around for the nut with the other. It was slow work, and the whole blacksmith shop was at a standstill. Time was money. John did not wait to consider, although he knew how awful some people thought it to use a wrench as a hammer, but he hit the head of one of the bolts with the wrench. This let him give the nut several turns with his fingers. Then he banged the bolt again with the wrench and kept on doing it as long as he gained anything by it. After that he tightened up the nut as best he could. He served the other bolts in the same way, and before he got through that wrench had several signs of abuse, but the blacksmith shop was running. He might have done the job without marring the wrench, but it was dangerous and difficult to climb where he found it necessary with even a wrench. A ladder could not have been placed conveniently because of machinery, stock and forges beneath, and even if placed, would have had to be moved several times, and time would be lost going up and down. With greater respect for the wrench John might have called for someone to throw him up a hammer. Unless he had a voice like a calliope it would take some guessing to find out what he wanted, and after bolts, waste, tongs, and an oil can had been held up for his inspection someone might think of the hammer. After that they could take turns in trying to throw it so that he could reach it. After it had fallen all over the shop, and had knocked over several piles of stock and forgings, or at least the men had knocked them over trying to catch it, John might catch it, and would be lucky if he did not jar the wrench off while he was using the hammer, and then they could repeat the performance with the wrench. If one or the other of them did not knock a tooth out of a gear on the shears or put dents in the ways of the bulldozer it was simply a matter of luck.

The time lost this way would pay for three wrenches, and if the "old man" was watching the performance, if he was a "practical man" he would have a worse opinion of John as a jobbing hand than if he had caught him chipping at the vise and using the wrench as a hammer. Under ordinary conditions that would be vile practice.

John knew all of these ways of saving the wrench and not "getting there" but he didn't consider them. He wanted to see the blacksmiths working. Perhaps it was his ability to do a job up quick that made the foreman put him at such jobs, and as John thought it over he could not recall that the foreman had ever found any fault with him for abusing tools, although he had heard men in the shop get "Hail Columbia" for it. Perhaps the conditions were different.

The jaws of that wrench were badly sprung and John had done it. Well did he remember the time. He was out on a job at a mill. It was "miles from anywhere," in the night, and the owner said that he must run the next day. Just why any designer must put a nut where a wrench could go on in only one way John did not stop to consider. That was the right way when the nut was being put on, and perhaps the designer did not think it would ever have to be taken off, or more than likely he never thought of a man with a monkey wrench. A cute little wrench that would never be there a month after the machinery was installed would be just the thing, and might be furnished with it, but the chances are that that same wrench would be used in the shop where the machine was built, and kept there.

John was afraid to pound much on the nut because it was a hexagon, and such a nut is bad enough to hold without being bruised. After that wrench had slipped off several times John tightened it up so that he had to drive it on with a hammer. Then it held, and John braced himself and put his foot on the handle and pushed. Then he hunted up a piece of pipe and put that on the handle, and really he did not care for the wrench if it would only hold until the nut started; and it did, and when he had turned it as far as it would go he had to hammer it and pry on it, and sweat to get it off the nut, and when he did get it off it was not as good looking as it had been when he put it on, but the nut was loose, and that nut was the key to getting the job done.

On another job it was a socket wrench that was needed, but it was not there. Did you ever need to get a nut off in a hurry when it was back under a flange in plain sight, but where it was beyond the reach of any commercial shop wrench when used in the proper way? John did think of splitting that nut off but it was an old timer and in this day of system and order he knew that if he did he would not find another one like it even if he lost a day and went back to the shop for it. It was nominally a seven-eighths nut, but the actual diameter and pitch of thread might be almost anything. The chances of finding one that would fit around the place were too small to be given serious consideration. As the interfering flange did not extend much beyond the nut John set the jaws of the wrench a little tight for the nut, and then drove them down over it. This let him get the nut about half way into the jaws before the handle struck the flange. Of all weak ways a wrench is weakest when used in this position. It is lots worse than pulling backward instead of forward, and lots of people insist that forward is the only way a wrench should ever be used. With this hold the pull is sideways. As that gives a narrow hold on the jaws, they spring under much less pressure than with the other direction of pull. John knew this, as it was not the first time that he had abused a wrench in this way, but he drove it on tight, and of course that sprung the jaws. He cut a piece of board and put it so that it braced the wrench sideways, so that it would not twist off when he pushed on it, and by getting his shoulder against the wall and his foot on the handle, he made it move. He had to throw his weight into a surging jerk to do it, and the board slipped out, and the handle came up hard against the flange, and was pried off the nut, and John took an undignified seat on the machine.

He sprang up and tried the wrench on the nut, and found that it had been started; he then examined his shin to see whether he had lost some skin, or whether it was only a bump. When he got back to the shop he caught the wrench in the vise, and got some of the side bend out of the bar, but he got some more in on the next job, for the wrench came in very handy in a confined place

where he used it as a lever to pry two pieces apart.

He might have saved that handle some, but when a man is away up on the top story of a high building on one of those jobs where he has to be everything because he is just shown the job and left alone with it, he wants to get away as soon as he can. Had he gone down into the basement and found somebody and proved that he was not a sneak-thief he might have gotten a piece of wood to drive on to save some finished parts from being marred, but he used the wrench handle, that is, after he had split his hammer handle bunting with it.

That wrench has been in use for over two years. Besides the abuses I have told about, it has been used to drive drills into sockets, and to twist drills that have had the tangs broken off, out of the socket. It has been put into holes and hammered on to drive something else out. It has been used as a battering ram. It has been used as an anvil, and if there is any abuse that it has not received, John is very willing to see that it gets it if he can make better time on a job by doing so. He has an idea, mistaken it may be, that it is not so much his business to see how nice he can keep the company's tools as it is to see how cheaply he can do their work. He does not think that he ever abused that wrench to the disadvantage of the company.

Yes, the foreman knows John and he knows that wrench, and he has had to stand between John and the "old man" more than once. He has discharged men in the shop for abuse of tools too, and often the abuse was not anything compared to what John had done, but he only smiled at John. No, John was not particularly a favorite of his, not a bit more than any other man who was willing to do the best he knew under the conditions at hand, but 'way back in the foreman's mind was a picture that he often looked at. He had seen it when a very young man, and it had made a strong impression on him. The picture was something like this: A large barrel lay on its side. A partition divided one end of the barrel from the other. The one end of the barrel stood where it could be readily seen and examined, and was where it was passed and repassed continually. To get to the other end one had to know all the ins and outs of the place, and be able to put on old clothes, and get down into low, disagreeable places, and climb, and twist, and squeeze, and work.

Some one in authority had discovered a leak in the end of the barrel that was plainly to be seen, and with cup, magnifying glass, and stop watch he was measuring it. On the other side of the partition the fluid was spurting out in numerous leaks, any one of which was many times larger than the one under observation. No one but the workmen ever saw the leaks on the back side, and any attempt by them to stop the leaks there made the one under observation on the front side drip a few drops more a day and there was trouble. The barrel had supply pipes running in and discharge pipes running out, and these were in constant use.

In the foreman's mind the contents of that barrel represented the money a firm handled in conducting its business. The leak in front represented the loss caused by proper abuse of tools perhaps, and the leaks behind represented the losses caused by over and unsuitable system, useless rules, unpractical theoretical refinements, ignorance of actual shop conditions, ignoring of human nature, lack of faith in the good intention of the average man, niggardliness in supplying proper small facilities, a belief that all wisdom was kept in the office and such things. He had been on all sides of the barrel, as he was a shop man who had spent many long years getting out work as a machinist before he ever had charge of men, and he did not believe in saving a cent, and having it cost seven to do it. He had heard of the section boss who had two men hunt for a missing spike for three days on account of the rigid system enforced by the division superintendent. That was not the ideal to which he wished to conform. He wanted to get the best net results possible under the conditions.

Even a battered monkey wrench must not be taken as conclusive evidence that the one who battered it is a shiftless, no-account man, whose room is better than he is, unless the conditions under which he battered it are known and understood.

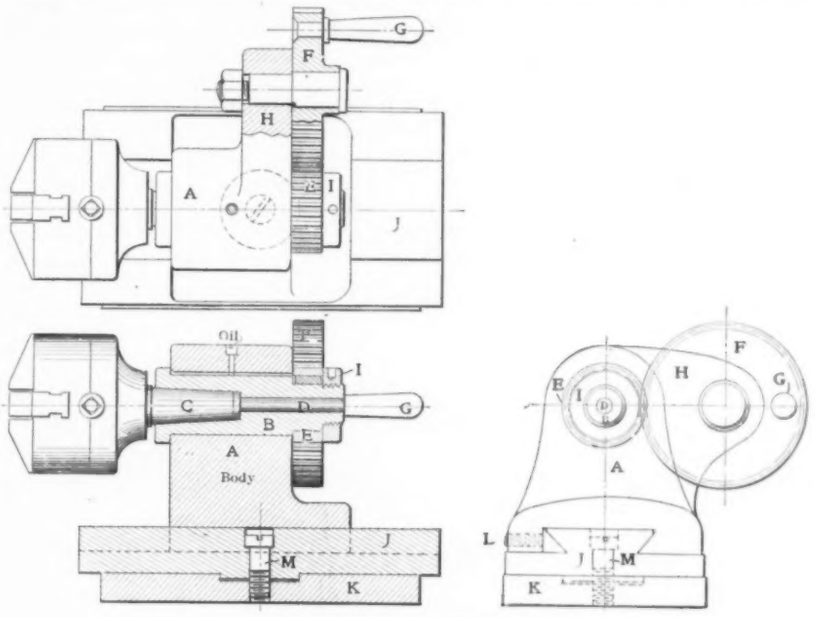
W. OSBORNE.

In Germany there are over five thousand alcohol engines in use, principally on farms and in small shops doing light work.

Letters to the Editor.

Attachment for Disk Grinders.

The illustration shows a small attachment I have made and used with great success on disk grinders. It can also be used with advantage on any grinding machine which has a table for it to rest upon. The construction of it is as follows: The body *A* is of gray iron, and carries a steel spindle *B*, bored at its front end to take a standard taper plug *C*. The small hole *D* through the spindle is for convenience in knocking the plug out. In the sketch a small drill chuck used for holding small articles, such as screws, pins, studs, etc., is shown on the taper plug. To the other end of the spindle



THE GRINDER ATTACHMENT.

is keyed a small steel pinion *E*, having 24 teeth, 12 pitch. This pinion is driven by a gear *F* with 48 teeth, which is carried by a stud supported by an arm *H* extending out from the body. A handle *G* is fixed in this gear for rotating it by hand. The pinion is held on the spindle by a lock-nut *I*. The body slides along the upper base *J*, and *J* rotates on the lower base *K*. Thus a combination of a horizontal sliding movement can be obtained together with a circular movement.

For spherical grinding the body *A* can be locked at any position along *J* by means of the set-screw *L*, according to the radius of rotation required. The work is held in the chuck, and the combination of rotating the spindle in one direction together with the body turning round in the recess in the second base gives a spherical movement. For parallel grinding *J* can be locked by means of the screw *M* and the body *A* slides along the base. By locking it at an angle, taper work can be ground. If two of these attachments were used with a bench grinding machine, where the face of an

emery wheel is available, they would do the same work as a small universal grinding machine. The attachments could each be fitted with a dead center, and shafts could be ground in this way without much trouble. Then again, if the spindle were fitted with an index plate, square, hexagon or other shapes could be ground. If necessary the spindle could be fitted with spring collets instead of the chuck for holding the work. The latter uses are only suggestions for your readers, and have not been tried by me.

England. CONRAD.

Some Mechanical Contradictions.

It has always been a question in my mind whether a man grows wiser in proportion to his years, or whether after all, the little he learns intuitively in a life time is not more than offset by the clearer perception of his own ignorance and his own faults. The engine lathes of fifty or sixty years ago were marvels of perfection as we thought. The light, slim, dog-leggy beds of those times would certainly be a marvel now. By comparison the present lathe is a monster. The old 18-inch lathes had spindles 1½ inches diameter of iron. Now they are 3 or 3½ inches of steel, and the material used now is only limited by the necessity for easy handling. That is the progress of the times.

Locomotive people have followed the same lines and we have all learned by their example. Yet after all, the road bed of at least some of the leading roads is anything but satisfactory. Built on the wave and fiddle theories combined, a close examination gives a severe shock to an admirer of good tools and machinery. To a casual observer the rails are in a constant vibration under the heavy trains, but to a critical observer they bend so much in occasional spots as to appear frightfully dangerous. It is a very common thing to find the ends of the rails deflected an inch by every truck—not so much on main as on branch lines—at the immediate rail joint while they remain solid at the next tie less than two feet away.

If the guide bars of a locomotive were deflected one tenth of that amount, engineers would be frightened. Or if the column of a drill or other machine tool were to yield a tenth of an inch it would be condemned. These rail lines are sanctioned by the best engineers and must, therefore, be all right, and this convinces me that I have learned to be too fastidious or that the railroad people are too reckless. Of one thing I am quite sure, that I dare not build steam engines on that principle. The marvel of it all is, that bessemer steel will stand so much abuse in a rail and so little in machinery, and the rest of us so little. It makes me think the little I have learned in a lifetime is all on the side.

C. W. CRAWFORD.

Some Shop Conditions in Chili.

I came to this country in 1879, about the finish of the Peruvian war, and started work in what was then a small shop, though now it is a pretty big one for this country. I won't mention any names, but for meanness this shop "takes the cake," even today. The owner combined the functions of superintendent, engineer, draftsman and foreman in one, and if I was filing a little brass would come and place a piece of paper round the vise, saying: "All that is money." I have often seen him in the office, with a pair of glasses on, with a handful of filings or turnings, laboriously separating the brass from the iron by blowing on it, or taking out the iron with a 5c. magnet. We got a new drill press one time. I wanted to keep the table from being drilled full of holes like the other one, so told the boy not to drill holes in it, but on it. Before he had worked a week at it, I saw a ⅞-inch drill going right through it, and called his attention, but he said, "*Esta bueno, patron, podia usar la misma otro vez*" or, in English, "That's all right boss, we can use the same hole another time." There are about 400 persons employed here, and of those only 40 are men, and some of these are working for boys' pay, which is from 75c. to $1.50 a day, Chilean currency (an American dollar is worth here $3.50). If a boy thinks he knows a little, and asks for a raise of salary, he gets put off week after week till he leaves of his own accord; then they take another boy of 14 or 15 years, and repeat the process.

I have seen only about 20 micrometers in the whole country in all the years I have been here, and those have been for the most part "made in Germany," with the barrel divided in 100 parts, and the screw metric. They are very flimsy, and a man with a strong hand can make them measure 20 per cent. smaller than one with weak hand. Half the fellows (natives) that saw the one I brought from home thought it was a sort of screw clamp for fastening work together, and were incredulous about my being able to measure a hair with it. ALFREDO PRINCE.

Valparaiso, Chili.

Brazing in the Machine Shop.

A general knowledge of the art of brazing is very valuable in the machine shop, much more so than many mechanics realize. Many times a broken piece may be saved by brazing when no other method in vogue in the average shop could be put in practice. Many a new job has been made more secure; many jobs have been done at much less expense; many a broken piece has been saved by brazing that could not have been in any other way.

Many machinists look with distrust upon brazing, and feel that it is not a mechanical way to do things, but until I find some good reason for discontinuing the practice, I shall keep on brazing when, in my opinion, it is a good thing to do.

The accompanying sketches illustrate a few jobs on which brazing was resorted to with uniformly good results. Fig. 1 represents a piece that we had to get out in half-dozen lots. Instead of taking 2½-inch round stock the full length of the

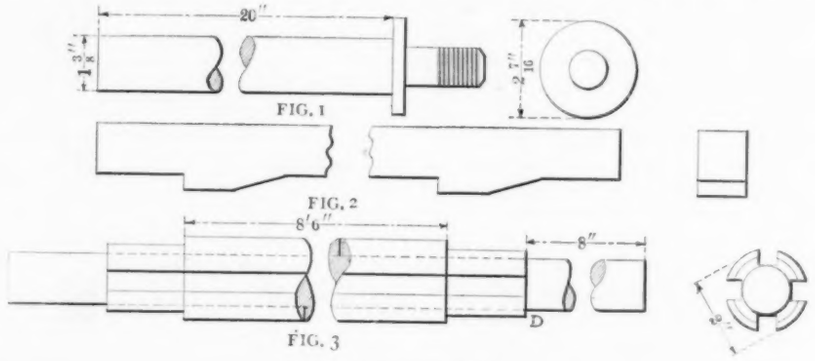


FIG. 1

FIG. 2

FIG. 3

SOME BRAZING JOBS.

piece, as had been the practice in another shop, we made rings 2½ inches in diameter, 1¼ inches bore and ⅜ inch thick. We then cut some 1 7/16-inch stock 22⅜ inches long—the total length required—and turned one end down to 1¼ inches diameter for 2⅜ inches on one end. The collars were slipped up to this shoulder and brazed, being held in position by burs raised with a chisel on the 1¼-inch side; this was not objectionable, as this part was finished to 1 inch diameter after brazing. These pieces were produced for about one-half the cost of turning from the solid 2½-inch bar. We might have had rings made by the blacksmith, but I think the way it was done was much better.

Fig. 2 shows a piece of ⅝-inch square steel ten feet long, having lugs as shown every six inches. These lugs were subjected to strains and shocks that no rivets would stand. We riveted the lugs with a ⅛-inch rivet, and then brazed them. This was done far quicker than would have been possible if we had cut it from the solid. Fig. 3 shows a shaft about ten feet long, in which were four keyways. This shaft was brought into the shop one day broken off at *D*. As the break caused the

stoppage of a very important machine, it was necessary that we lose no time in getting it started. A new one would be a big day's work for a good, lively man. A day's delay was a serious matter. Now how would your non-brazing mechanic proceed? Welding seemed to be out of the question; and then, too, we were machinists, not blacksmiths, so we brazed it. We first ascertained that this break occurred while the shaft was doing its legitimate work, showing that the margin of safety was practically nil. Rivet holes through the shaft would not make it any stronger, so we put the shaft in the lathe and bored the end. For the first inch we bored it 1¼ inches—the size of the broken part—then we dropped down to 1⅛ inches for two inches more. We fitted in a piece of 1⅜-inch round stock and brazed it, then finished it to size. Time for the entire job, 2 hours and 10 minutes, and the job better than new, as we used a better grade of stock.

CHAS. A. TRASK.

A Device for Bending Copper Bars Edgewise.

Where there is not enough of this class of work to keep an expensive and special machine busy, the device shown will do excellent work and comparatively rapidly. Often in electrical work on large machines it is necessary to wind large coils of flat copper varying in size from ¼x2 to ¾x3½ inches edgewise.

Fig. 1 shows the device on a 42-inch vertical boring mill, though a 60-inch mill will do as well, the third bend having been finished. *A* is the main part or body, shown in detail in Fig. 2, made of cast iron of suitable dimensions. Parts *B* and *C*, Figs 3 and 4, are also of cast iron, the circular part of *B* fitting in groove *a* cut in *A*. This acts as a big hinge as *B* rotates forth and back 90 degrees on *A*. *C* is firmly screwed to *A*, thus holding *B* in place. After bolt *D* is inserted in position the device is ready to be firmly bolted to the table of the mill by bolts inserted in cored places *H*. The object of not using lugs on part *A* is to avoid the danger of miscellaneous tools such as hammers, wrenches, etc., getting caught between them and the housings of the mill, thereby causing an accident. It is necessary that the mill should be fitted with a brake and a reverse belt or controller.

I wish to call special attention to the piece of cold-rolled stock shown at *L*, Figs. 1 and 3, as it performs two duties, and should be of the same thickness as the copper stock being wound, so that in making the fourth and all following bends, when the part of the coil marked *II* comes around in position it would strike the shoulder of hinge *B*, thereby distorting the work, and probably injuring the device or the mill, whereas otherwise one can let pointer *K* pass the mark a trifle so as to allow for the springing back when the work is released. It also acts as an adjustment for the different widths of copper, as it is impossible to take it up on the opposite side, on account of getting out of line with the outer radius of bolt *D*. The device should be made so as to allow ⅜-inch strip on the widest stock used. Strip *LL*, shown in Figs. 1 and 4, should be at least 1 inch wide in all cases, its thickness corresponding with the width of the copper. As the copper feeds in about 1⅞ inches in making the bend, it is necessary to have a guide to hold it in place, and on that account adjustable rollers *G*, Fig. 1, and roller socket *G*, Fig. 5, are used. Hinge *B*, Fig. 3, is shown with two slots 1 inch square with two headless screws in bottom of each for adjustment. Roller sockets are of 1-inch square stock with a ⅝-inch hole bored through their entire length, with a piece of ⅝-inch round Stub's steel inserted

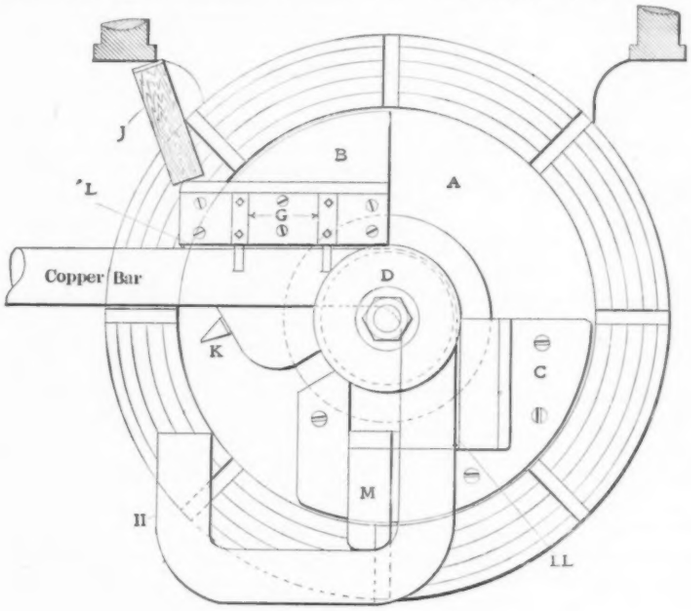


FIG. 1

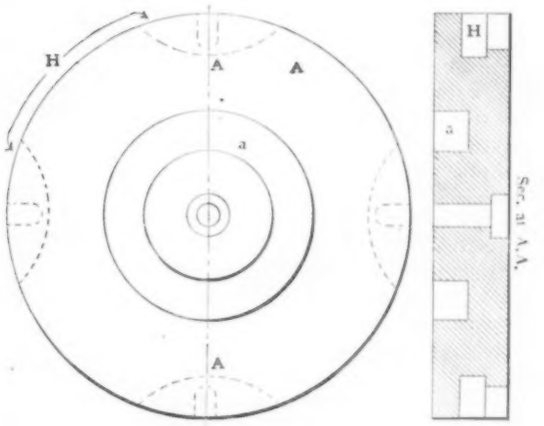


FIG. 2

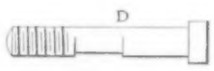


FIG. 4

FIG. 5

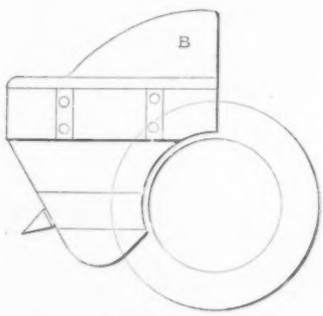


FIG. 3

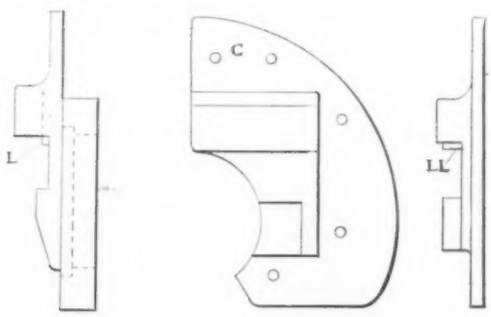


FIG. 4

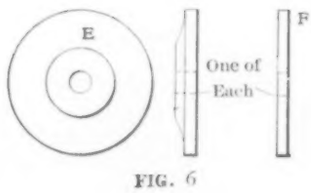


FIG. 6

BENDING COPPER BARS EDGEWISE ON THE BORING MILL.

about two inches longer than socket which is firmly held in place by a strip of ¾-inch iron with two set-screws above each socket as shown at G, Fig. 1. When part *H* of coil strikes the rollers it shoves them back, therefore the need of a sliding roller guide. Part *J* in Fig. 1 is a piece of oak 2x4x18 inches with a piece of copper tacked on the end at the housing and to prevent splitting, and is used on hinge *B* when the mill is started to make a bend. Piece *M* is wrought iron ¾x2 inches to act as a stop to make all lengths uniform. When the coil is oblong two such pieces of different lengths are used, and merely laid one at a time in place and not fastened.

When starting a coil the table of the mill is rotated backward until the bending ledge of *C* comes in line with *B*. The copper bar is then pushed through and the mill table is given a quarter turn. The table is then turned back and the bar is pushed through for another length, using the gage *M*, when another bend is made, and so on. Either right- or left-hand rotation can be had, according to make-up of the device.

The copper should be soft drawn and annealed before bending.

SCRIBLETS.

Soldering and Brazing without Heat

Here are two ways of soldering or brazing without heat, which your contributor who requests information at page 521 might find useful.

1. Take one ounce of sal-ammoniac, one of common salt, one of calcined tarter and three of antimony. Pound well together and then put the mixture in a covered crucible over a slow fire to get hot by degrees. Keep up the fire until the contents of the crucible are melted. Then cool gradually and when cold pound fine. Place the pieces that are to be joined together, fill the joint with the powder and brush a solution of borax dissolved in hot alcohol, over the joint with a feather. The powder will immediately boil up and as soon as the boiling ceases the consolidation is effected.

2. Take ¼ oz. of hydrofluoric acid, 2 oz. of brass filings, and 1 oz. of steel filings. Put the filings into the fluoric acid; when dissolved touch the pieces to be joined with the acid and press together. Put the acid in an earthenware bottle as it will dissolve glass.

THOS. R. HASSALL.

Keeping Taps, etc., Straight while Tempering.

The tendency of reamers, taps, etc., to bend in hardening, may be overcome, to a great extent, by striking a sharp blow on the end of the blank resting on a solid block or anvil, using a soft or machinist's hammer if the ends are protected by sheet copper. Any machinist should be able to judge the force of blow so as not to injure the reamer. If large, several blows may be struck. This should be done before heating as it is the heating that bends and not the cooling. In machining a strain is set up in the steel that the blow relieves.

I have used this method for years with both high-speed and carbon steels, keeping ⅞-inch stay-bolt taps 28 inches long, straight, dropping them in water from the tongs. This is especially useful for inserted blades for reamers, taps, etc.

Erie, Pa. H. J. WHITE.

Split Dies—Keeping Track of Press Tools—Holding Dies.

At page 423 J. L. Lucas shows a die of sectional construction. May I ask him what kind of a fit he obtained after hard-

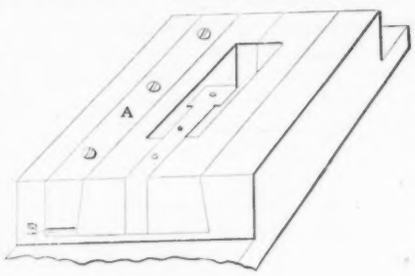


FIG. 1

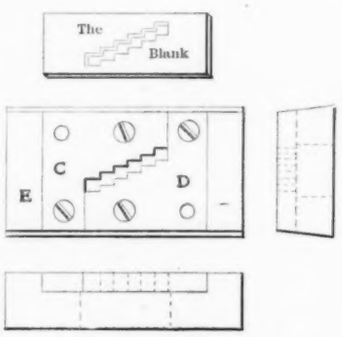


FIG. 2
SPLIT DIES.

ening, by interlocking the sections as shown? The sectional or split die is economical, but I think the plain joint is the best, because dies of split construction have a habit of changing when tempered. To hold a die similar to the one Mr. Lucas shows, I would make a machine-steel shoe of sufficient thickness to support the tongue properly and would bevel one side 10 degrees and leave the other straight. On the straight side there would be a steel pin like *A* Fig. 1. An inspection of this sketch shows that the thickness of *A* does not equal the depth of the opening in the shoe at *B*. This member being fastened with fillister head screws forces the sectional members of the die together and permanently retains the die in the shoe.

In Fig. 2, I show an example of a split perforating die. The members *C* and *D* are of tool steel and are retained in the machine-steel holder *E* with flat-head screws and dowel pins. The blank is of 16 gage half hard brass and is located on the die by a nest gage. To construct this die in the solid would have been a mean job, but by making it on the sectional plan it resolved itself merely into an accurate piece of milling.

Mr. Lucas takes up the question of the care of dies. I don't think this phase of the business is so serious as he would have us believe. If you have one man who receives the dies, puts them away, knows what they are for, whether they need repairing or not, in fact knows every operation the dies perform, it will pay you to pay this man a fair wage to stay with you and the dies will not be misplaced and ill used.

I know a firm that has in its specially arranged vaults, over 30,000 sets of dies, and one man has charge of these. Every group or set of dies for doing a certain job or operation is numbered; the figures are stamped in large type. No one but this man touches the dies while they are on the shelves in the vaults. He has done this work for nearly twenty years, and can go in there in the dark and bring you the dies for any operation performed in that factory. I don't say this is the best system of caring for these tools, but it is one of the many, and I think it pays to keep a man who "does things" for you, until money goes out of circulation.

CARROL ASHLEY.

At page 423, J. L. Lucas asks what is the best way, or the one most used, for holding dies in the shoe. It would, indeed, be difficult to say what the best way is; and it is very doubtful if the best way

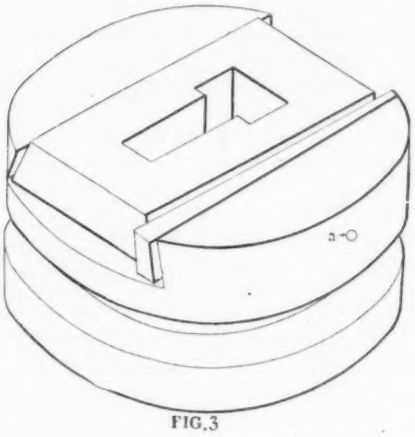


FIG. 3

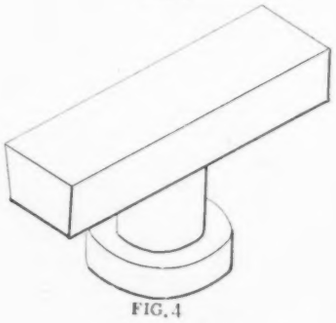


FIG. 4
HOLDING DIES.

for one shop would be the best for all. Fig. 3 shows a simple method, and for small work it is very effective. It has the advantage of being easily and quickly applied, but it requires some judgment on the part of the man who sets the dies. A light driving the wedge is usually sufficient to hold the die firmly, and anything more than the necessary pressure may cause injury to either die or shoe. The dies are made with parallel sides in the direction of their length, and the shoe and wedge are made tapering. One or more liners may be used in connection with the wedge. Dies are quickly and easily secured in the shoe by this method, and the only tools necessary are a box of liners and wedges and a light hammer.

Another quite common way is to make the shoe somewhat larger than the one shown in Fig. 3, and insert a gib like that shown in Fig. 4, the shoe being slotted to receive it. A set-screw is placed at *a*, for securing the die in place. This arrangement works well when the gib is well fitted, but if the stem is too long the die is liable to work loose. For larger dies it is common practice to use several set-screws abutting directly upon the die, but it is better practice to use a slotted gib which is held down to the shoe by cap-screws. I have never found anything better than this for medium-sized dies. I clamp large dies directly to the bed of the press without any shoe.

WILBERT S. DREW.

J. L. Lucas in his article at page 423 gives two views of a built-up die, which I myself have used in a number of instances in the past few years, both in the enamel and tinware lines. In his description he makes mention of the fact that the work can be done by a cheaper class of help, an idea that I think should not be entertained for an instant in a tool room or a machine shop that has anything to do with even the simplest kind of die work. That cheaper class of help proposition may be all right in an ordinary job shop, but for my own part, I have found it very poor policy in die work. Very frequently in the columns of the AMERICAN MACHINIST, reference is made to this same matter-of-fact proposition: What are we to do with our better class of workmen? Let us give them more encouragement for they surely are deserving of it.

Regarding the matter of keeping track of press tools, I will try and give an explanation of a system I helped to inaugurate a few years ago.

In this particular factory they first tried stamping on the die the name of its particular kind, but found that it was not a very good plan after there were three or four hundred dies on hand; later another plan was tried of stamping the dies with a number that was recorded in a book; this did not seem to give any better results than the first as the foreman of each department had to spend considerable time in locating the particular die he wanted. One year while taking stock we decided to try the following plan:

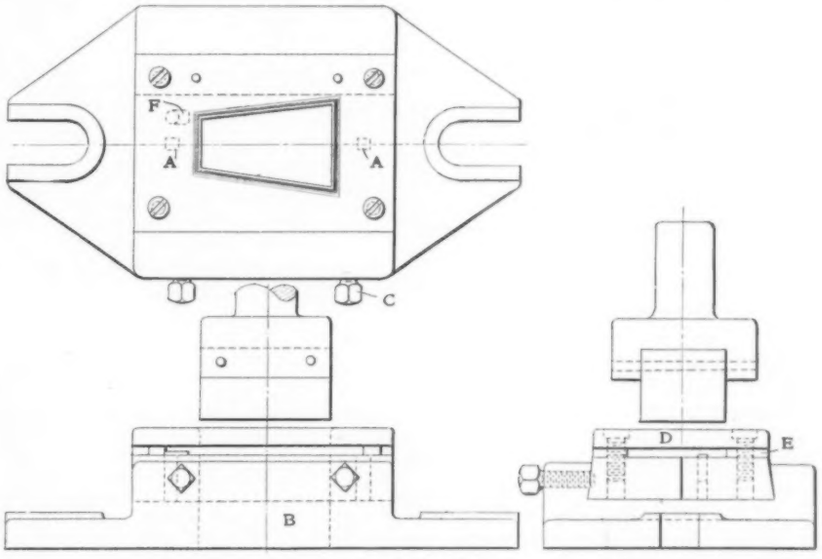
We first had a punch made that would stamp an ellipse about 1x¾ inch. This was so that we would not have to obliterate the old marks that were on the dies, some of them being marked four or five times. It was of course understood that the genuine mark was the one enclosed by the oval. Then we gave each type of die a certain letter; for instance, round blanking dies came under series A. The sizes were designated by figures; for instance, a die 1 inch in diameter was marked "100" and one 1½ inches diameter was stamped "150," the numbers running from 100 to 200, giving 100 sizes (from 1 to 2 inch) according to the decimal equivalent of the size of the die. Drawing dies had another letter, for instance, B, and were numbered the same way as the blanking dies, starting at 100; then shelves were prepared for each die. The sizes ranged from top to bottom, the small dies or those starting at A-100 being on top and the sizes gradually increasing toward the bottom, which left the large dies in a position where they would be easy to handle. Each compartment was numbered by a brass check, nailed on the shelf containing the dies, and each article was recorded in a large book, by the superintendent. The foreman of each department was furnished with a blue-print of the dies for use in his department, and in the die room there was a large print, covered with glass, containing a list and the arrangement of the whole thing for the information of the man in charge of the room. Then each foreman was furnished with a lot of small tickets suitably printed. When he wanted a certain size of die he would refer to his list, and would see that the tool wanted, which, we will say, was a 7½-inch round cutting die, was A-750; then all he had to do was to mark his ticket accordingly and send a boy with it to the die room. The man in charge would hand him out the die, at the same time inserting the ticket which the boy gave him from the foreman, in a small holder made to receive it.

This ticket acted as a check against the die and was released when it was returned. After we had the system in operation a month there was not a particle of trouble, as by that time the die keeper was familiar with nearly every die used and could almost place his hand on the one wanted in the dark. There were no more dies lost, for just as soon as the man in charge of them noticed one out longer than usual, he would start a hunt and locate it usually in the machine shop.

In his article Mr. Lucas also asked for information as to the best method of holding dies in the shoe or bolster. I think the common way of doing this is by set screws. I am enclosing a sketch of the method I follow, the bolster being provided with a taper key which securely fastens the die. I have not seen it used much except by myself, but I believe that it is as cheap as the set-screw method and there is no trouble with screws breaking.

F. ROSS.

[We do not reproduce the sketch sent in by Mr. Ross as the scheme for holding the die is practically the same as that shown in Fig. 3 by Mr. Drew.—Ed.]



A SPLIT DIE.

Split Dies.

Mr. Lucas, at page 423, mentions the absence of articles on split dies. Perhaps the method of making them in a large establishment where I was once employed may interest some of your readers. The inclosed drawing will explain the method.

The die is split and keys are inserted as shown at *A*, the die being held in a gray-iron holder *B* by means of two set-screws *C*. *A* stripper *D* is fastened to the die by

means of four fillister-head screws. Between the stripper and die is doweled a guide strip *E* for the stock. A pin *F*, with the end bent over and flattened to a suitable size is driven in the die to act as a stop. The punch is secured in a gray-iron holder, by means of taper pins clearly shown in the drawing. P. A. R.

A Pattern-Shop and Storage System

Some time ago there appeared in the AMERICAN MACHINIST a little verse tending to ridicule an excess of system, which ended by saying that they were so busy making out cards that nothing else was done. While an elaborate system would in some cases be worse than useless, I believe that in a large business where thousands of details need constant regulation in order to have things run smoothly, system is the only sure way of getting results. If the writer of the verses referred to was sincere in the sentiment expressed, I very much doubt if he has been actively connected with a business of this kind. It seems apparent that system is only the logical result of the complexity of our modern methods of manufacturing. Where the management is controlled by up-to-date business men, I am positive that no system would survive if its results did not show an actual saving of dollars and cents after all expense had been considered. There are many large manufacturing establishments in this country whose systems are so elaborate that to fully comprehend them would require weeks of study. Surely that fact alone proves the value of system, for the sole aim of all our factories is profit.

Naturally, discretion must be used in forming a new system, or in the consideration of one used by others, and careful study should be given it by all who will be affected by its use, before it is adopted. Of course the smaller the plant the less system is required. From the stated experience of others it would seem that the average system was not at first an elaborate one, but was developed step by step as the conditions of an increased business, more varied output and consequent larger factory demanded. I know that has been the case in our shop. When the plant was in its infancy, no system at all was used, not even that of checking tools. The workmen took tools and returned them to the tool-room personally, and at their leisure. Soon difficulties arose, and a man was put in charge of all the tools, seeing that they were properly checked, and he was held responsible for them. Thus the first step in system was made, and since then these steps have been numerous and are the result of obstacles encountered in the regular routine of business and after their adoption, with necessary amendments which experience suggested, they seemed indispensable. There was no complex theoretical system adopted in its entirety, but although it is very elaborate, our system has grown by degrees through actual requirements and is based on practical experience.

The following method is the one we use for keeping accurate record of patterns and castings. Needless to say all of our departments are similarly systematized and the one described is only a section of the complete system of the plant.

Our pattern storage is a three-story brick building, the walls of which have no windows and the doors are of metal. It is well lighted from the roof with skylights, the upper floors being in the form of galleries with a light well in the center of the building. The building is apart from any other by a distance not less than 20 feet in order to further lessen the danger of fire. The lower floor, which is used for the heavy patterns, is divided into compartments, while the upper floors are fitted with shelves for the smaller parts. The shelves run at right angles to the wall in order to economize space and get better light. Incandescent lamps with long cords are also used, and are so placed as to be accessible in any part of the building. All compartments and shelves are numbered consecutively. The patterns received are placed in convenient unoccupied spaces and the shelf or compartment number is entered opposite the pattern symbol number in a book kept for the purpose. No attempt is made to classify by location as we found this confusing. For instance, if all the patterns of a certain machine were kept together, their varied sizes would not permit placing them to advantage. So an accurate record is kept of the location of each piece, and they are placed promiscuously, following no order. It is only necessary to know the number of the piece when, by referring to the record, its location can readily be ascertained. A man has charge of this building, and his duties include everything which is covered by the proper care and storing of the patterns.

Orders for all materials and finished parts are made out in the cost department. When castings are wanted this department makes out a card similar to Fig. 1. If wanted immediately the words *in turn* are crossed out, or, if they are to come in their regular order, as are those on the card shown, the *at once* is cancelled. This card is sent in duplicate to the man in charge of pattern storage. He places the cards in a temporary file and makes out cards similar to Fig. 2, a separate card for each piece. If the castings are wanted at once a special red card like Fig. 2, but marked *rush* is used. With the record book before mentioned the patterns are easily found and a card, Fig. 2, is tacked to each piece. They are then sent to the foundry. When the necessary number of pieces are cast the cards are again tacked to the patterns after a number of the circles shown have been punched corresponding with the number of good castings obtained. They are then returned to the storage. The punching of the holes requires a little more time than would be necessary for writing the figures, but we believe it to be better for the reason that the average molder is not over cautious and his figures are sometimes hard to read, and again he usually spends time finding a pencil. The punching can be done with anything pointed; usually the tack which had held the card to the pattern is used. The man at the storage house compares the attached card with his order, and when

Jan. 6, 1906 ORDER NO. *76301*

CAST FOLLOWING IN TURN ~~AT ONCE~~

No. Wanted	Symbol Number	TITLE
25	5360	#4 *Bed*
25	7891	#4 *Drive Pulleys*
50	7898	#4 *Gear Brackets*
50	6285	#4 *Hangers*
50	6289	#4 *Hanger Boxes*
		O.K. and Return *J.B.F.*

FIG. 1

Date *Jan. 7, 1906*
Order No. *76301*
Pattern No. *5360*
No. Pieces *25*

FIG. 2

Jan. 10, 1906

CHANGE PATTERN FOR *Cone Pulley* #*1067*

AS SHOWN BY DRAWING #*4532*

Steps increased in width ¼"
Bore Changed from 1¼" to 1⅜"
Hub Lengthened to come flush with ends of pulley

O.K. and return to Drawing Room *D.A.B.*

FIG. 3

CHANGE
BEFORE MAKING CASTINGS FROM THIS
PATTERN

FIG. 4

A PATTERN SHOP AND STORAGE SYSTEM.

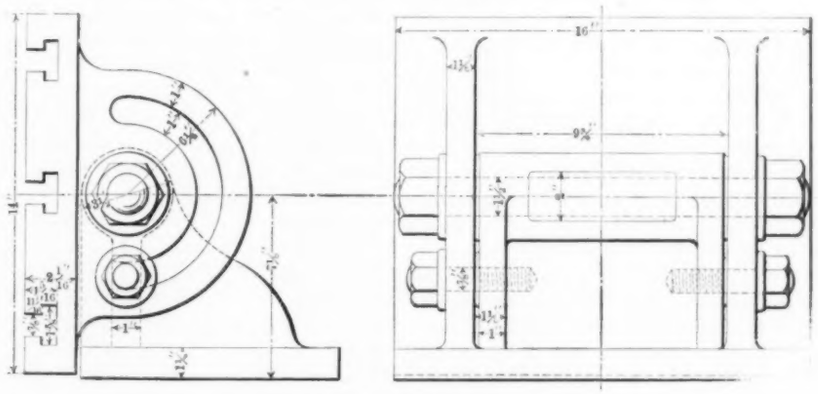
everything called for on the order is out he signs the original and its duplicate, puts one in a permanent file and sends the other to the cost department where it is also filed, after having been checked against the order book.

When castings are to be altered by reason of a change of design of a machine the drawing-room makes out card like Fig. 3 and sends it to the pattern shop where it is filed. This file gives the foreman a list of all the patterns to be altered. At the same time the card is sent out, cards like Fig. 4 are numbered on the back with the respective symbol numbers and sent to the pattern storage where they are placed on the patterns to be changed. This eliminates any danger of castings being made from them before the necessary alterations are made. When the pattern shop is ready to make the change, the drawing given on the card, Fig. 3, is sent for, and when the job has been finished the card is O.K.'d and returned to the drawing-room, where it is placed on file.

While there may be some factories in which this system would not apply as a whole, yet I believe it has good features which will serve to advantage in any plant where castings are used. In our shops it seems ideal and there should be no reason why it would not be found so in any shop manufacturing the same line as ours, which is machine tools. L. F. B.

An Adjustable Angle Plate.

The illustration shows an adjustable angle plate which we have found very



AN ADJUSTABLE ANGLE PLATE.

useful for use on the boring mill, planer and drill press. You will observe it has a wide range. The cut explains it sufficiently without a written description.

ISAAC MORGAN.

Power Transmitted by Worm Gearing.

At page 505 Wm. H. Raeburn gives a diagram for designing worm gearing. I wish to state that this diagram was originally published by Otto Gruson & Co., Magdeburg, Germany, and the only thing needing change for English or American use was millimeters to inches for the pitch of teeth in the worm wheel and for the greatest pitch diameter of worm.

H. B.

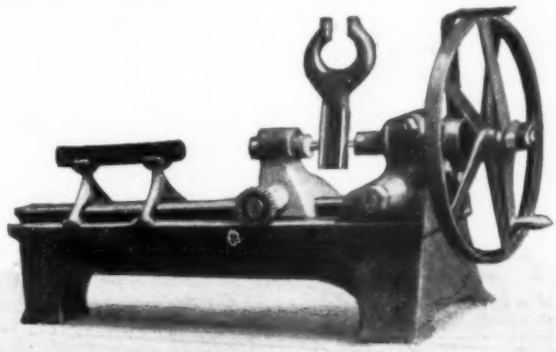
A Collection of Comments.

Some recent articles in the AMERICAN MACHINIST rather put it up to me to reply. Walter Gribben's improvement on my two-tail dog, as shown at page 455, shows how easy it is to get over difficulties when they are pointed out. What I did was to invent; what Mr. Gribben has done is to design, and as designing is a rarer thing than inventing, I will have to take off my hat to him, figuratively speaking, and to say that if he will only get someone to make and use the dogs, I shall be satisfied.

At page 489 Mr. Simmons again brings up the subject of chatter caused by a loose spindle in the lathe, but, as I believe I said at the start, one man's experience is worth more than all men's opinions; if he finds that reversing the direction of his lathe stops the chattering, that's the thing for him to do. I do not, however, much like the suggestion that if a lathe spindle is kept a proper running fit, that the box will have to be taken up every week, and to the extent as to require the shaper to do it. We have a number of lathes running that do not chatter, and no one seems to remember when the boxes were taken up.

I am not ready to believe that a lathe used in back gear with a cut that will require the back gear, or when turning anything of considerable size in open gear will not wear the top of the box.

I am glad to be set right about the Newall Measuring Machine as shown by Mr. Storey at page 488, and to say that his plan is decidedly better than mine,



THE CORNELL MEASURING MACHINE.

while the spirit-level method of indicating the pressure is decidedly the best of all the schemes yet devised. The first and likely the poorest of all the schemes was that used in the Cornell machine; in that machine the wheel was turned by friction, and when the contact points abutted against the piece being measured the turning handle would slip. As the screw came up to a dead stop the wear on the face of the ratchet thread was very small, if anything, but in the case of the Newall machine with spring abutment it would be greater.

The adjustable zero in the Cornell machine which rendered it unnecessary to set the sliding head with any very great degree of accuracy, was I believe, new, and I wonder at the other makers not using it.

The Cornell machine was illustrated and described in the *American Artisan*, published in New York, on the first page of the November number, 1874, in an article on measuring machines in *Cassier's Magazine* some four or five years ago, and an illustration of it is given herewith.*

I notice that a couple of your contributors have been amused at Entropy's way of designing a boring mill. The first one seemed to express his amusement, but did not tell how to do it, and the second to a certain extent has done so, but I will venture to guess his methods will amuse as many as Entropy's.

If I recollect correctly Bodner designed the boring mill about three-quarters of a century ago, and since then, here and there, one or another has de-

*For this illustration we are indebted to the courtesy of *Cassier's Magazine*.—Ed.

signed an improvement on some feature, such as running the table on a track, etc.: but in the main, machine-tool draftsmen have been making plans for different sized machines.

It seems to me that a good way to begin on the job would be to find out what there is wrong about the present machines, and if nothing, copy the plan; or if anything is found to be wrong, try and change the design to correct that and follow the rest of the plan. Or if one wanted to introduce some new feature, invent or design it, and leave the rest of the machine alone.

Would it not be the hight of foolishness to start out as if nothing had ever been done when there is the result of a life-time's experience at hand? If one were a William B. Bement, who said "the figures would help him to guess," it might do, but there are not many William B. Bements. JOHN E. SWEET.

Industries of San Francisco.

In view of the recent disaster in San Francisco any figures relative to its recent commercial status have a more than passing interest.

We find from statistics just received that the foundries and machine shops held a very considerable place, as their number had increased from 102 in 1900 to 140 in 1905, and the capital invested from $5,225,591 to $9,162,700. The number of salaried employees carried on the books increased from 320 earning $128,455 to 467 receiving $667,061. At the same time the average number of wage-earners increased from 3202 receiving $2,135,048 to 3462 receiving $2,598,879.

There was a decrease in the miscellaneous expense from $704,074 to $695,019, and on the cost of materials used from $3,728,365 to $3,541,168; on the other hand, there was an increase in the value of the output from $8,366,967 to $9,077,299. Just when, if ever, the balance of these statistics for San Francisco will be forthcoming, will be hard to say.

A. F. TENNILLE.

We have heard of would-be humorists telling boys who did not appear to be cut out for a trade or business that they had better enter the ministry. This old joke would have small force in a town near Reading, Pa., where there are three ministers working as machinists in a large machine works, two of them because their congregations are not self-sustaining, and the other because the loss of his voice compelled him to give up evangelistic work.

The great Union Station at Washington, D. C., though a good way from completion, was entered on April 12 by the first passenger train, a special carrying an inspection party.

Engineering Reminiscenses.*

BY CHARLES T. PORTER.

In the years '74 and '75 I was filled with eagerness to get the engine on its legs again, and tried a number of schemes in vain. One morning I read in the paper that Alexander L. Holley had just returned form Europe, where he had been making a tour of the steel-making establishments, studying both the bessemer and the open-hearth or Siemens-Martin processes, on a scheme of interchanging improvements in manufacture between American and foreign licensees under both these systems.

It occurred to me that Mr. Holley might be the very man I wanted. If he could be got to recommend the engine to the steel makers, they might take it up for their own use. I had not applied the engine in rolling-mill work, but felt sure that it would prove especially adapted to that service. So I called on Mr. Holley at his home in Brooklyn. I had never before met him, but I found that he knew something about the engine from its exhibition in Paris, and from his brother-in-law, Frederick J. Slade, then an officer of the New Jersey Steel Company, and who was one of the engine's warm admirers. I have already mentioned Mr. Slade and the help he gave me while in Paris in solving the problem of piston acceleration.

So I found no difficulty in arranging with Mr. Holley to take a trip with me, and visit some of my engines in operation, for the purpose of forming a judgment as to its suitability for the use of his clients. This he agreed to do as soon as he had finished the report of his trip, on which he was then engaged. Our inspection took in the engines running in New York and Brooklyn and vicinity and in New England, finishing with the engine at the Arlington Mills in Lawrence. They were all found to be on their best behavior, but Mr. Holley told me that the engine at Lawrence, which was running there at its intended speed of 150 revolutions per minute, impressed him more than all the rest put together; not that it was doing any better, for they all ran equally well, but solely because it was larger. It made him awake to the great possibilities of the engine.

On his return Mr. Holley prepared a report on the performance of the engine, and cordially indorsed it as sure of ultimate general adoption. But he found capitalists to be absolutely dead. Not even his great influence could awaken in them the least interest. The time for the promoter had not yet come. And still my success in winning Mr. Holley's support proved to be vital to my subsequent progress.

As a last possible resort, I finally thought of Mr. Phillips of Newark. The firm of Hewes & Phillips had become dissolved by the death of Mr. Hewes, and so, by purchase of Mr. Hewes' interest from his heirs, Mr. Phillips was the sole proprieter of the largest engineering works in New Jersey. That concern had some time before the death of Mr. Hewes given up the manufacture of steam engines, a style made by them having proved unsuccessful, and confined themselves to making machine tools. In this line their business was exceedingly dull, being disastrously affected by the depressed and stagnant condition of the times.

I found Mr. Phillips ready to listen to me. He said that what he knew about the engine was favorable, although he had not heard of it for the last two or three years, but he was willing to consider a proposition to take up its manufacture. I told him frankly that I had no proposition of that kind to make. I wished to get the manufacture of the engine revived, but to retain the business in my own hands, to carry it on myself, in my own name, with the view of gaining for the engine a reputation that would enable me to command the capital necessary to establish its manufacture in works that I had long before planned for that purpose, and in which I could devote myself to the development and building up of the business; that I hoped to be able to reach this point in the course of two or three years, when probably the anticipated financial revival would fill his works with business in his own line of tool making.

He said that my proposal was entirely inadmissible, that he could not permit any independent business to be carried on in his establishment, and stated firmly the impossibility of any arrangement of the kind I suggested, which would be something quite unheard of. I stood firmly on my own position, but was obliged to leave him without any sign of yielding on his part. The negotiation was, however, renewed, exactly how I cannot now recall, but it ended in my carrying my point. We finally concluded a bargain, in which I held on to the business, but of course had to insure to him pretty much all the profits. I was conscious that I could never have accomplished this, but for the extreme stagnation of the times; but was not aware of an additional reason which impelled Mr. Phillips to agree to my terms, when he found he could not do any better. What this reason was will appear pretty soon.

The arrangement was to go into effect as soon as I got an order. This was my next job. I learned that Mr. Peters, a manufacturer of high-grade knit fabrics

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in Newark, all which by the way were sold by him to importers in New York, was carrying on also a manufacture of light oil cloths in Newark in temporary quarters, and was building a large structure for this purpose in East Newark, the building now and for many years past occupied by the Edison lamp manufactory, and was in the market for an engine. I called on Mr. Peters, and got from him the privilege of submitting an estimate for this engine. For this purpose I went to his then present works, and measured the amount of power he was using, and found that one of my 8x16 engines would give him that power with the additional amount he wished to provide for.

On calling with my estimate early one morning I found Mr. Peters ready to bow me out. He told me that he had been informed that the high-speed engines had proved a failure, and the manufacture of them had been abandoned three or four years ago. I said to him, "Mr. Peters, I would like to make you a proposition." He replied that he would hear it.

I then said, "Your engineer, Mr. Green, I suppose never saw a high-speed engine, but he strikes me as a fair-minded, cool-headed man. I have three engines made by me in Harlem, and which have been running from four to six years, two in New York and one at the J. L. Mott Iron Works at Mott Haven. These can all be visited in one trip. I propose that you send Mr. Green to see them in operation, and talk with the engineers and owners, and learn all about them, and that you suspend your decision until you get his report." "That is a fair offer," said he. "I will send him today." I called again the next day, and found Mr. Peters ready to throw the order into my hands. Mr. Green told me afterward what his impressions were. In the most cool manner, entirely free from any excitement, he said: "My only wonder is that everybody does not use this engine, and that all builders don't make it. I got the same report everywhere. Would not have anything else. Costs less money, occupies less space, burns less coal, needs less attention, never cost a cent for repairs, never anything the matter, never varies its speed."

And so I began business in Mr. Phillips' shop, where I continued for four years, the most delightful period in my active life. I had Mr. Goodfellow in his old place as my foreman, and three or four of my best men back again at the work they loved. Everything went smoothly and harmoniously, and the business grew pretty steadily until the orders thrust upon me became larger than I could have filled if I had had the whole works to myself.

One day, two or three weeks after we commenced work on this engine, Mr. Phillips' bookkeeper came to me, and said: "Mr. Peters' engine is contracted to be running on the first of May, is it not"? "Yes." "Do you think it will be ready"? I replied that the work was in a good state of forwardness, and I thought most likely it would be running before that time. I should say that was a size for which I had made the revised drawings already, and the old cylinder pattern had been readily altered to the new style. "Well," said he, "Mr. Phillips is a little short today, and would be much obliged if you would give him your note for a thousand dollars to come due, say, the fifteenth of May." So I gave him the note, the engine was ready on time, accepted and paid for, and the note met at maturity.

This was the beginning of a uniform process, which continued for four years. It was disclosed that Mr. Phillips' financial position was the same as my own, neither of us had a cent of money. The way we managed was this: I always afterward required payments in instalments, one-quarter with the order, one-quarter when the engine was ready for shipment and the balance when running satisfactorily. Thus with my notes we got along famously. My orders were always from first-class parties, engines always ready on time, always gave satisfaction and promptly paid for. I had many thousands in notes out all the time, and never had to renew a note. Mr. James Moore, of Philadelphia, the celebrated builder of lathes for roll turning, once long after remarked to me, "I keep my bank account in the shop." It occurred to me that I had always done the same thing.

Directly after we got running, I received a letter from William R. Jones, superintendent of the Edgar Thompson Steel Company, running a rail mill recently started at Braddocks by Carnegie Brothers, saying that they were in need of an engine to drive a circular saw at a very high rate of speed, to cut off steel rails cold. They had been recommended by Mr. Holley to get one of mine, and if I could furnish a suitable engine immediately he would order it. Fortunately I could. While I was building engines in Harlem, the city of Washington, D. C., went into the system of wooden pavements, and the contractor obtained an engine from me for sawing up the blocks. About the very time I received Mr. Jones' letter, I had learned that the wooden pavement system was being abandoned in Washington for asphalt, and the sawing mill was closed. I at once wrote to the contractor, making him an offer for the engine. I received by return mail a reply accepting my offer, and adding most complimentary words concerning the engine. These I remember closed by saying that his admiration of it was such that if he were able he would put the engine in a glass case, and keep it there as long as he lived.

The engine proved just right for Mr. Jones' use. I went myself to Braddocks to see it started. All were much interested in the governor action, I as much as anyone, for I had never before seen this particular application of it. In sawing through the head and web and bottom flange of the rail, the width of section being cut varied continually, and the gentle rising and falling of the counterpoise, adjusting the power to the resistance, while the engine kept, so far as the eye could detect, a uniform motion, had about it a continual fascination. The success of this engine brought me several orders for governors, the most important of which was one from Mr. Jones himself for governors and throttle valves for his blooming-mill and rail-mill engines. I got up for him balanced piston valves, which operated perfectly. In iron valves and seats of this character it had been found, where the steam contained primed water, that their edges wore rounded, and their action in regulating the motion became less and less satisfactory. I knew that their boilers primed badly, and avoided this defect by setting brass rings in the edges. I did not think until too late for use now to inquire of the Southwark Foundry and Machine Company, if the drawing of these valves could be found. If it can, I will give it later; if not I will sketch from memory a section, showing how these rings were secured, so insuring the permanence of the perfect regulation of these engines.

Bulletin No. 46 of the American Chamber of Commerce of Paris is largely devoted to the subject of consular service reform, the leading article on this subject being by Arthur K. Kuhn of the New York Bar, member of the Chamber. The Bulletin also contains the record of resolutions adopted by the Chamber, commending the *New York Herald* for its campaign advocating the adoption of the metric system, and upon nomination by the Board of Directors, James Gordon Bennett, proprietor of the *Herald*, was unanimously elected an honorary member of the Chamber. This action is, as our readers probably know, taken by men who have business relations of one kind or another with American merchants and manufacturers, and are interested in the sale of French goods in America, or of American goods in France, and sometimes both.

An addition is being erected to the shops of the De Laval Separator Company, at Poughkeepsie, N. Y., which addition will inclose 21,200 square feet of floor space. It is of one-story sawtooth roof construction, the same in all essentials as we illustrated so fully some years ago, except that the roof trusses of the new addition are of steel. This additional space will be occupied mainly by new machine tools, among which will be seven of the new type Hartness Flat Turret lathes which we illustrated some time ago.

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Contents.

	PAGE
The National Bureau of Standards at Washington	633
Legal Notes	640
Visiting Industrial Establishments in Europe and America	642
The Design of Bending Rolls	644
The Printing Press in the Drawing Office	647
Echoes from the Oil Country—Use and Abuse of Tools—A Battered Monkey Wrench	647
Letters to the Editor: Attachment for Disk Grinders....Some Mechanical Contradictions....Some Shop Conditions in Chili....Brazing in the Machine Shop....A Device for Bending Copper Bars Edgewise....Soldering and Brazing Without Heat....Keeping Taps, etc., Straight While Tempering....Split Dies—Keeping Track of Press Tools—Holding Dies....Split Dies....A Pattern Shop and Storage System....An Adjustable Angle Plate....Power Transmitted by Worm Gearing....A Collection of Comments....Industries of San Francisco	649-656
Engineering Reminiscences	656
There is Still too much Ignorance of Costs	658
Telephone Business in New York	658
Parcels Post and Post Checks	659
New Publications	659
New Tools and Machine-Shop Appliances	660
Cornerstone of the United Engineering Building Laid	661
Meeting of the American Society of Model Engineers	661
Personal	661

There is Still too much Ignorance of Costs.

Most builders of machine tools believe that if in every tool-building establishment there was a thorough and complete system of cost accounting, unreasonable and unfair competition would be very much reduced.

It is this general belief perhaps which has led to action taken at the recent meeting of the National Machine Tool Builders' Association at Atlantic City, where a committee was appointed to investigate and report upon a standard method of keeping cost accounts.

It would seem clearly apparent that the first requisite toward making and maintaining fair prices for a manufactured article is to know what that article costs. In most establishments where only one machine is manufactured, the cost of that machine is pretty accurately known, but where, as in most establishments, more than one kind of machine is made, the knowledge of what each machine costs is often rather indefinite and sometimes ludicrously erroneous; the losses on one machine being sometimes covered by profits on another, and in other cases no adequate allowance is made for depreciation of buildings and equipment, nor for the renewals and improvements that must be made from time to time in order to keep up with the march of progress. That ignorance of cost sometimes leads to absurd results is shown by the recent experience of certain tool builders. A certain heavy machine tool was to be ordered, and a number of bidders were competing. The prices of most of these bidders ranged pretty closely around $3600, while the bid of one builder, who had not been in the business very long was $2500. Fortunately in this case the buyer threw out this lowest bid, believing that the one who made it did not understand the reasonable cost of the machine, and that the probabilities would be that there were other things which he would not understand, and that the attempt to do business with him would probably not be satisfactory. This action was in all probability fortunate for the low bidder as well as for the others, as it is certain that he would have lost money upon the contract, if he had obtained it. In another case, where gun carriages were to be built, it turned out when the bids were opened that the bids of those who had had previous experience in building such carriages were about $15,000, whereas one bid, received from a person who had had little or no experience in the work, was for $11,000. Nothing can be more certain than that this bidder lost money upon his contract He was bidding against shops that had had experience, which were thoroughly and admirably equipped for the work, and who were bidding against each other, with the intention of getting the work if there was a reasonable margin in it.

Prices based upon ignorance of cost are entirely too prevalent in manufacturing. Our contributor, Osborne, treated this question in an interesting manner recently in its relation to the foundry business, wherein the absurd practice is still entirely too common of making prices at so much per pound or per ton, merely in the hope that the general result will be all right; or in other words that those who are getting heavy, simple and comparatively cheap castings will pay enough more than they are worth to make up for the loss on smaller and more difficult castings.

It is to be hoped at least that the committee of the National Association of Tool Builders will throw additional light upon this subject. It is one which sadly needs enlightening, much as has been done along the lines of improved cost keeping during the past 15 or 20 years.

Telephone Business in New York.

A new telephone company which is trying to establish itself in New York City to compete with the present company, is, in the advertising pages of certain New York papers, carrying on an argument with the present company, which has a monopoly of the New York telephone business. Both companies are using considerable advertising space in this discussion, and they are making that space interesting. The one is showing the evils of a monopoly of such service; while the other is showing the evils of having two companies attempting to cover the same territory and entailing the necessity of having two telephones, two telephone books to consult, and two separate sets of telephone bills to pay.

The interesting feature of the case is that both these companies are right. There are evils connected with a monopoly of the telephone service, if such monopoly is absolute; that is to say, if it is left to the company to render such service as it thinks best, and to charge for the service all it can get or all the traffic will bear. On the other hand, there are well known and well recognized evils attending the operations of two companies covering the same territory. It is a nuisance, as everyone knows, and the solution of the problem would seem to have been arrived at in the European countries, where it was early recognized that there could be no such thing as competition in the telephone business with any advantage to anyone, and that in order to avoid an injurious monopoly, it would be necessary for the community or the state to control the business. It is there done in that way, with results which are entirely satisfactory to the people who use telephones. The charges are small and the service is satisfactory to

the people who use it, whether it would appear so to Americans or not. And in considering this matter of satisfactory service of publicly owned utilities, it is well to bear in mind that in foreign countries a great many lines of business are carried on in ways which we Americans are not accustomed to, and which would not be satisfactory to us in all respects. This is because the people of those countries have different customs and ideas, and are suited by things which, whether publicly or privately administered, would not fit our customs and ideas.

In New York it happens that we have the Merchants' Association which has made a thorough examination of the telephone business here and a report upon it. Upon the strength of this report, rates were, a short time ago, somewhat reduced, though they are still far above what appear to be rates proportioned to what they are in other places and are enormously higher than the new company proposes to make even after paying a large sum for a franchise—the old company's franchise having been free—at least so far as the city's treasury is concerned.

Since writing the above the board having the matter in charge has received from the Merchants' Association a letter signed by Clarence Whitman, Chairman, Henry R. Towne, and Gustav R. Schwab, in which the Association declares that the New York Telephone Company has definitely committed itself to the regulation of its charges; to the limitation of its earnings; to complete publicity of its affairs and to a supervision of its accounts by public authority. The Merchants' Association takes the ground that if the city can exercise proper control over the present company, there is no reason why any other should enter the field. It is urged that the company should not be permitted to charge more than enough to properly operate its business and to provide reasonable returns on its capital, and it is further urged that franchises should not be capitalized, that prospective profits should not be capitalized, and that when net earnings have exceeded a definite limit, the rates of charges to the public shall be correspondingly reduced. It is stated that the officers of the present company have expressed a willingness to restrict their net earnings to approximately 10 per cent., and it would seem as though this would be altogether the best arrangement that could possibly be made under the circumstances.

The most encouraging and the most significant feature of the whole case perhaps is the fact that the two companies contending for business in New York have, by the method referred to above, specifically appealed to the public instead of confining their work and efforts to public officials, charged with responsibility in such matters and who have too often in the past been subject to grossly improper influences. The fact that a company strongly intrenched, as the New York Telephone Company is, particularly by its ownership of conduits within which its wires are placed, should thus virtually surrender its absolute monopoly, and place itself under the control of the municipality is remarkable. It is to be presumed that it would not have done so had not competition by a new company seemed the more uncomfortable of the two horns of the dilemma.

Parcels Post and Post Checks.

Some recent events make it seem not unlikely that we may have a parcels post and other improved facilities for carrying on trade throughout the country by means of the Post Office organization. When we have these we shall only be even with, not ahead of, the other civilized nations of the earth, practically all of whom have long enjoyed these advantages.

The interests that are opposing advance along these lines are the express companies and various associations of retail dealers and jobbers in hardware who object to and strenuously oppose new ways of doing business. A contemporary which is their chief organ is devoting pages of space to attacks upon the parcels post idea and the proposition to introduce post checks, the latter designed to facilitate the sending of small sums of money through the mails.

Lists of the members of Congressional committees who have these matters in charge are printed and all who are interested in preventing this increased facility for the transaction of business are urged to write to those whose names are given condemning the proposed action. All this is apparently upon the theory that the only way to do business is to have manufacturers at one end of the line and consumers at the other, while between them are jobbers and retailers. As a matter of fact many manufacturers do business direct with consumers almost entirely and most of them do at least a portion of their business in that way.

Nothing can be more certain than that reasonable and fair rates for carrying merchandise through the mails and greater facilities for sending small sums of money by mail will be in the interest of the people and of manufacturers generally. While certain interests may be properly enough opposed to them from their own standpoint, it is exceedingly doubtful if even these interests will in the long run find themselves seriously prejudiced.

Facility of trade between the various sections, States and cities of America has been one of the greatest factors in our material development. The local hardware merchant in a small town may be an enterprising, broad minded and progressive man; but too often he is the opposite. If he could do so he would have a village ordinance prohibiting the people of the village from buying drills, files or jack knives outside the village limits. The only thing which keeps such men in reasonable bounds is the fact that the people of a village can go outside, buy what they like and freely bring it in. Does any sane man believe that this has been bad for the country, or that it will not be good for all of us to afford every possible facility for the man in Kalamazoo to trade direct with the man in New York or New Orleans if he wants to do so?

We published last week, a reference to the differences between Secretary Taft and Ex-Chief-Engineer Wallace of the Panama Canal, in which we defended Mr. Wallace's action. *"Engineering News"* in its issue of May 10, however, publishes full abstracts from a recent report by Secretary Taft, in which he quotes from letters written by Mr. Wallace and others, which quotations seem to put a somewhat different light upon the matter, and to make it appear that Mr. Wallace simply wanted to quit his job because he had one offered which he thought was better; and that he gave little consideration to any interest except his own.

In a recent issue of *The American Jeweler* of Chicago, there is an article on "The Modern Clock" by Ward L. Goodrich, a large share of which consists of a reproduction of Walter Gribben's article, which appeared in our columns some time ago, describing a method of measuring the diameter of an escape wheel with an uneven number of teeth. Mr Goodrich gives no credit either to Mr. Gribben or to the AMERICAN MACHINIST for this article, but it is published as though it were entirely his own.

New Publications.

The Practical Carpenter very properly exposes the work of an author, Fred T. Hodgson, who according to our contemporary pretends to have written a book called "The 20th Century Bricklayer's and Mason's Assistant." It is found that the book is copied almost exactly from various English works, with little or no credit to the original authors, and without even taking the trouble to change the dimensions of the bricks from the English to the American sizes. Authorship of this sort cannot be too severely condemned. It is the same in principle as the appropriation to one's self of any other kind of property belonging to another, and should be known by the same name.

The experience of metallurgists is that the strongest and hardest aluminum bronze is the following:

Copper	89.0%
Aluminum	10.5%
Silicon	.5%

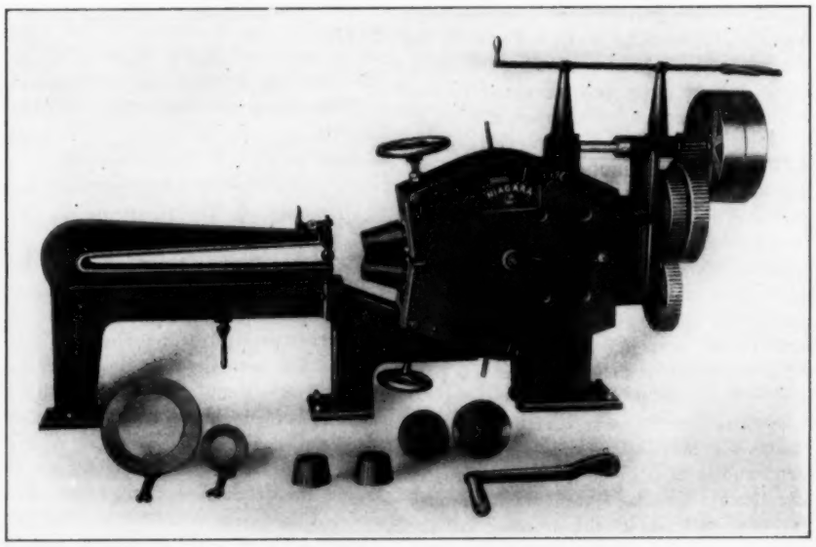
New Tools and Machine Shop Appliances.

MACHINE FOR CORRUGATING METAL GASKETS.

The accompanying illustration shows a machine for corrugating gaskets of light sheet copper, steel or brass. The material is previously cut into disks of proper diameter by means of circle shears of the type that is suitable for cutting internal circles, as the shears are also used for cutting out the center after the rim is corrugated, unless the inside diameter is so small that the holes must be punched out. The arm in which the material is clamped while being corrugated, is adjustable for disks from 3 inches to 48 inches diameter. The conical rolls are made to conform with the desired shape of the corrugations, and in width up to 5 inches. It is an important feature of the machine that both shafts are inclined, and that the angle of the shafts can be varied as may be required to give the proper position of the corrugating rolls for work of different diameters, and so that the material can be pinched more or less in the inner or outer corrugations.

The roll shafts are mounted in rocking boxes, the rear end of which is carried by yokes. Either end of the roll shafts can be raised or lowered by means of hand wheels. The inclined shafts are driven by universal couplings from parallel shafts. The gears connecting these shafts always remain in the same mesh. The illustration shows the machine with the casing that covers the one side of the corrugating head removed.

The machine is made by the Niagara Machine and Tool Works, Buffalo, N. Y.



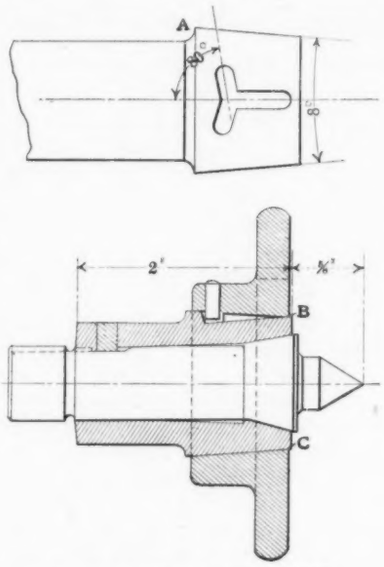
MACHINE FOR CORRUGATING METAL GASKETS.

SCREW PLATES WITH ADJUSTABLE TAP WRENCHES.

The sets of screw plates manufactured by Wells Brothers Company, Greenfield, Mass., under the trade name "Little Giant" are now being supplied with adjustable instead of the old style tap wrenches.

IMPROVED FORM OF NOSE FOR BENCH LATHE SPINDLES.

The accompanying engraving illustrates the improved form of spindle nose now used by Hardinge Bros., of Chicago, Ill., in the construction of their Cataract bench lathes. As this type of spindle nose is provided with a plain taper, it may be hardened and ground true, and all fixtures used on one lathe can be changed to another with the assurance that they will run true. The retaining slot in the nose, which slot is formed at a slight angle as shown at *A*, to assure the chuck or other fixture being drawn back snugly in place on the taper, is made right and left hand as indicated so that the fixture will be automatically tightened in place regardless of which way the lathe is running. This feature is of especial importance where a chasing attachment is used on the lathe requiring the spindle to be run backward. It will be noticed that the bottom of the slot, indicated at *B*, is milled parallel to the opposite line of the taper nose as shown at *C*, this giving the slot ample depth at the working portion without weakening the spindle nose.



BENCH LATHE SPINDLE NOSE.

A REVERSIBLE TAPPING ATTACHMENT.

The illustration shows a reversible tapping attachment applicable to drill presses etc. Fig. 1 shows a section with the tapping spindle *M* in position to drive the tap. Fig. 2 shows the spindle *M* in the position it occupies when withdrawing the tap.

A is the taper shank fitting the spindle of the drill press. *B* is the body of the device made in halves and held together, in this case, by the nuts *C* and *D*. A handle *B*¹ prevents it from turning with the spindle. Keyed to *A* is the bevel gear *E* which meshes with a bevel gear *F* mounted in a stud *G* secured to the body. The motion of the gear *F* is transmitted to the gear *H* mounted on the sleeve *I* journalled in *J*. It is obvious that the direction of rotation of the gear *H* is opposite to that of *E*. The lower end of the shank *A* has a tapered hole in it, as has also the upper end of the sleeve *I*. The spindle *M* has an external double taper the same as the tapers in *A* and *I* but slightly shorter so that it can engage with only one of them at a time. The lower end of *M* has a threaded sleeve *O*

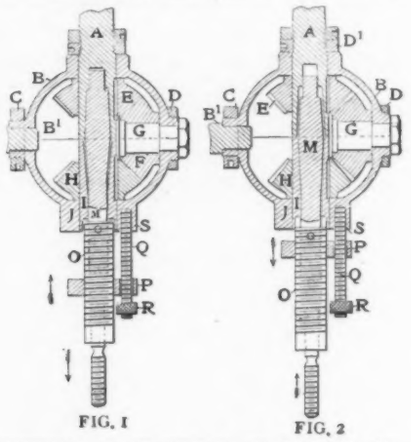


FIG. 1 FIG. 2

INTERNAL CONSTRUCTION OF TAPPING ATTACHMENT.

FIG. 3. A REVERSIBLE TAPPING ATTACHMENT.

fitted over it. A threaded collar *P* fits the thread in *O*. Secured in the lower part of the body *B* is a threaded stud *Q* reaching through a hole in the collar *P* and having an adjusting nut *R*. It is obvious if the taper spindle *M* is in engagement with the taper in *A* and the machine is started the threaded sleeve *O* will turn and the collar *P* will be gradually drawn up toward *S*, when *P* reaches *S* the sleeve *O* and the spindle *M* will be drawn downward; *M* will be released from engagement with *A* and will engage with the taper in *I*; the direction of rotation of *O* will be reversed and the tap will be withdrawn. While the tap is being withdrawn, the collar *P* is being advanced toward the adjusting nut *R*, when it reaches *R* it has the same effect—that of reversal—on the spindle that it had at *S*.

At Fig. 3 the tool is shown together with the collets used for holding the taps. This device is made by the Mutual Manufacturing Company, Bridgeport, Conn.

Corner-Stone of the United Engineering Building Laid.

With little or no ceremony or display the corner-stone of the new United Engineering Building in West Thirty-ninth street, New York, was laid May 8 at 5 p.m., Mr. and Mrs. Carnegie taking part in the ceremony.

No direct representative of the membership of the American Society of Mechanical Engineers was present or invited, and the ceremony was witnessed only by the committee having the building in charge and a few invited guests; among whom were John Fritz and Chas. H. Haswell. The corner-stone, which was laid with the structural work of the building nearly completed and under roof, contained among other things records of the three societies which have charge of the building, a complete proof set of United States coins, which were struck at the United States Mint in Philadelphia on Monday previous to the corner-stone laying, and a gold plate on which was engraved the presentation letter from Mr. Carnegie.

Mr. Carnegie being called upon for a speech responded very briefly, and said to the representatives of the engineering societies: "I congratulate you upon the near completion of this building. Here engineers can consult with one another and cultivate friendship. They can form a brotherhood which will be of great benefit to all. The principle of union in science is as important as it is in politics." Noticing Mr. Haswell, now 97 years old, who was seated upon the platform, Mr. Carnegie said: "I would not say how many millions and a half I'd give to reach his age." He said that the presence of this—the oldest living engineer, and the first steam engineer of any navy—reminded him of a quotation from Kipling, which ended with: "O Lord, ye ken we need an engineer," and, said Mr. Carnegie, "O Lord, ye ken we need engineers, and what would the world do without them?"

Meeting of the American Society of Model Engineers.

The society held its second meeting at the Berkeley Lyceum, 19 West 44th street, New York, on Wednesday evening, May 2. There was a good attendance and several new members were enrolled. Constitution and by-laws were read and accepted. T. F. Barclay gave a half-hour talk on shop work with lathe and shop tools. This was followed by a discussion of various subjects, including the slide valve. Mr. Stoye gave a clear and concise explanation of the functions of the locomotive slide valve and the link motion. Members present were requested to bring samples of their work for exhibition at the next meeting. Mr. Stoye promised to give a talk on small tools and their uses in model making, and to bring some tools for examination. The next meeting will be held at the Berkeley Lyceum on May 23 at 8.30 p. m. A cordial invitation to be present is extended to all who are interested in model work. Anyone wishing to join this society should communicate with the secretary, W. E. Spon, 123 Liberty street, New York City.

The ninth annual meeting of the American Society for Testing Materials, which is affiliated with the International Association for Testing Materials, will take place at Atlantic City, N. J., June 21-23. The headquarters will be at the Hotel Chalfonte, and it is announced that special rates have been arranged for members of the society and their guests. It is expected also that the attendance will be sufficiently large to secure reduced railroad rates on the certificate plan. The indications are that the meeting will be largely attended, and an interesting one.

A new thing for draftsmen has been brought out by the firm of E. G. Soltmann, 125 E. Forty-second street, New York. It is called "Inkoff" and is used for removing black waterproof drawing ink from tracing cloth, which it does perfectly and without in any way altering the surface of the cloth.

Personal.

J. T. Flavin has been appointed master mechanic of the Chicago, Indiana & Southern Railroad Company, and the Indiana Harbor Railroad Company, with offices at Hammond, Ind., and Kankakee, Ill.

At the last directors' meeting of the Engineering Agency, Inc., Chicago, Ill., A. G. Frost was elected president and R. D. Smith and P. W. Herring were re-elected to the respective offices of vice-president and secretary-treasurer. The agency already has a branch office in Pittsburg and expects shortly to open offices in New York and Denver.

Wm. Clegg, Jr., who has been special agent of the Westinghouse Electric and Manufacturing Company in their St. Louis territory, has received the appointment of acting manager of the St. Louis office. D. E. Webster, formerly manager of the office, has been transferred to a position in the Chicago sales office of the company. J. S. Tritle has been appointed acting manager of the new district office opened by the Westinghouse Electric and Manufacturing Company in rooms 512 and 513, New England building, Kansas City, Mo. Mr. Tritle was formerly connected with the St. Louis office of the Westinghouse Electric and Manufacturing Company.

Announcement is made of the appointment, effective September 1, of Dr. W. K. Hatt as Professor of Civil Engineering at Purdue University, succeeding Professor W. D. Pence, resigned. Professor Hatt has been identified with Purdue University since 1893. He graduated from the University of New Brunswick in the Arts Course in 1887, and from Cornell University in Civil Engineering in 1891. After filling an instructorship in Civil Engineering at Cornell University, and a professorship in Civil Engineering at the University of New Brunswick, he was appointed Associate Professor of Civil Engineering at Purdue University in 1893, and afterward Professor of Applied Mechanics in 1896. Since this time, with the exception of two years leave of absence, he has been in charge of the Department of Applied Mechanics and the Laboratory for Testing Materials of Purdue University. He has had a varied experience in the practice of civil engineering along different lines, particularly in railroad location, construction and maintenance, chiefly on the Intercolonial Railroad of Canada. He served two years as Town Engineer of West Lafayette, Indiana, and since 1903 has been in charge of the Timber Tests of the Forest Service, United States Department of Agriculture. Under his direction a program of investigation was mapped out in 1903 and has since been executed at laboratories established at Yale University, Purdue University, the Universities of California, Washington and Oregon, and in a laboratory at Washington, D. C. That the Purdue Laboratory for Testing Materials may continue to have the benefit of Professor Hatt's direction, its organization is to be incorporated with that of the School of Civil Engineering. Professor Hatt will also continue to act as Consulting Engineer for the Forest Service, United States Department of Agriculture, Washington, D. C.

Business Items.

The Grant-Nelson Tool Company has removed from Chicago, Ill., to Grand Rapids, Mich., and this firm will hereafter be known as the Krieger and Nelson Tool Company.

The Cushman Chuck Company, Hartford, Conn., has just opened a store at 38 Cortlandt street, New York City, with J. C. Pierson as manager, and will carry a full line of chucks in stock to supply the trade.

The Whiting Foundry Equipment Company, Harvey, Ill. (suburb of Chicago), has under way a number of important additions to its plant. The extensions comprise a new pattern shop, 44x96 feet, and an addition, 52x130 feet, to the machine shop.

A. P. Witteman & Co., manufacturers of the Gantt hardening and tempering furnace, and representatives of the Cyclops Steel Works, Titusville, Penn., manufacturers of Burgess high-speed steel, have moved from Cherry street to larger quarters at 1223-1225 Spring street, Philadelphia, Pa.

The Main Street Iron Works, which were destroyed in the recent cataclysm in San Francisco, have secured temporary quarters at 1024 Francisco street, that city. This company would be glad to receive catalogs of machine tools, etc., to replace those lost and destroyed in the great fire.

The Lunkenheimer Company, of Cincinnati, Ohio, on May 1, 1906, opened a well-equipped branch store at 66-68 Fulton street, New York City. Previous to the above date this company maintained a suite of offices in the Havemeyer Building, 26 Cortlandt street, through which offices the export trade of the concern was transacted.

Schumacher & Boye, Cincinnati, have purpurchased the property recently occupied by the Dreser Machine Tool Company. The plant of the latter company was burned out in March last. This addition to their property will enable Schumacher & Boye to largely extend their plant, and they will at once erect a modern concrete building, including a power plant of 100x63 feet.

The Abner Doble Company, engineers and water-wheel manufacturers of San Francisco, announces that its works and offices on Fremont and Howard streets were entirely destroyed by the fire of April 18. Temporary offices have been opened at the residence of President F. A. Doble, 2611 Broadway, between Scott and Devisadero streets, San Francisco, where the business of the company will be conducted for some little time.

The Cling-Surface Company, of Buffalo, N. Y., manufacturer of Cling-Surface for belts and ropes, has just moved into a new plant, which it has erected in Buffalo at 1032-1048 Niagara street. This new plant is of the most modern fire-proof construction—brick, concrete, hollow tile and wire glass for wall, floor and ceiling. The increased domestic and foreign business of the plant has necessitated the change and the present new plant trebles its capacity.

On account of the great increase of its business during the past year the Independent Pneumatic Tool Company, of Chicago, Ill., has been compelled to secure larger quarters for its Pittsburg and New York offices and has moved its Pittsburg office from the second floor of the Germania Bank building to the twelfth floor of the Farmers National Bank building, and its New York office from the thirteenth floor of the Broadway-Maiden Lane building, 170 Broadway, to the sixteenth floor of the same building.

The Atlas Machine Company, Waterbury, Conn., has been incorporated under the laws of the State of Connecticut, has equipped a shop at 37 Canal street, that city, and is going to build special machinery of all kinds, metal and wire-working machinery, and do jobbing and repair work. The officers of the company are Alexander W. Limont, president, formerly master mechanic of the Holmes, Booth & Hayden Co.; Andrew Gardner, secretary, formerly with Waterbury-Farrel Foundry and Machine Co., and Adam Callan, treasurer, formerly with Waterbury Machine Company.

The Standard Roller Bearing Company, of Philadelphia, Pa., is now building a drop-forge plant, including building 80x120 feet, which will be equipped with drop-forge hammers 1200, 2000 and 3000 pounds each. It is also erecting a four-story building 210x100 feet, which will be devoted to the manufacture of annular ball bearings and a small portion of it to the manufacture of automobile axles. The above additions will give the Standard Roller Bearing Company a total of 355,000 square feet of factory floor space. It now manufactures everything used in its business, with the exception of steel bars.

Manufacturers.

The Kalamazoo (Mich.) Foundry Company will erect a new plant.

The Westerly (R. I.) Power Company will erect a new power house.

The O. K. Tool Holder Company, Shelton, Conn., will erect a new factory.

The American Multigraph Company, Cleveland, Ohio, will build a new factory.

The New York Edison Company will build a new power house, to cost $55,000.

The American Bridge Company is to erect a $2,000,000 plant at McKeesport, Pa.

The Winton Motor Carriage Company, Cleveland, Ohio, is building an addition.

The Berres-Gehl Company, West Bend, Wis., is to erect a new foundry and machine shop.

The Richmond (Va.) Foundry and Manufacturing Company is building a $100,000 plant.

The Otis Elevator Company will build an addition to the foundry at its Chicago, Ill., plant.

Headford Bros. & Hitchens Company, Waterloo, Iowa, has begun an addition to its foundry.

The People's Ice Company, Detroit, Mich., is building an artificial-ice plant to cost $125,000.

The General Electric Company, Schenectady, N. Y., has let contracts for another big shop.

The Lewis Eckels & Sons Ice Manufacturing Company, Baltimore, Md., will erect a new plant.

The Lehigh Valley Transit Company, Allentown, Pa., will erect a new machine and repair shop.

The Southern Sewer Pipe Company, North Birmingham, Ala., will double the capacity of its plant.

The Penn Hardware Company, Reading, Pa., will put up a new building, also a new boiler house.

The Springfield (Mass.) Foundry Company is planning to enlarge its plant, expending over $80,000.

It is reported that the Lewis Spring and Axle Company, Jackson, Mich., will erect a large steel mill.

The Norfolk and Portsmouth Traction Company will erect a new $100,000 power house at Norfolk, Va.

The Weir Stove Company, Taunton, Mass., is enlarging its plant by the addition of a four-story structure.

The plant of the Pusey & Jones Company, machinists and boat builders, Wilmington, Del., will be enlarged.

The W. L. Douglas Shoe Company, Brockton, Mass., is to erect a new factory building to cost nearly $70,000.

The Monarch Tool Company, Stamford, Conn., is negotiating for a site in Springdale on which to erect a plant.

The Carter-Chapman Company, manufacturing vehicles and auto bodies, Ludington, Mich., will double its plant.

The Witte Iron Works, Kansas City, Mo., will build a new gas-engine manufacturing plant, to cost about $40,000.

Catalogs.

Scully Steel and Iron Company, Chicago, Ill. Stock list for May and June. Illustrated, 4½x7, pp. 144, paper.

Craig Ridgway & Son Co., Coatesville, Pa. Pamphlet illustrating and describing latest improved steam hydraulic elevators.

The Ohio Pump and Brass Company, Columbus, Ohio. Catalog of the improved "Triumph" water lift. Illustrated, 6x9, pp. 23, paper.

The Ingersoll Milling Machine Company, Rockford, Ill. Catalog No. 15, describing heavy milling machines. Illustrated, 6x9, pp. 66, paper.

Mead-Morrison Manufacturing Company, Cambridge, Mass. Catalog "G," describing derrick-swinging machines. Illustrated, 6x9, pp. 20, paper.

The Wellman-Seaver-Morgan Company, Cleveland, Ohio. Catalog describing locomotive cranes, buckets and tubs. Illustrated, 6x9, pp. 31, paper.

Desmond-Stephan Manufacturing Company, Urbana, Ohio. Booklet describing Desmond diamo-carbo emery-wheel dresser. Illustrated, 3x5½, pp. 16, paper.

W. C. Toles Company, Irving Park, Chicago, Ill. Catalog of rapid-acting vises for woodworkers and manual-training benches. Illustrated, 6x9, pp. 36, paper.

The Schellenbach & Darling Tool Company, Cincinnati, Ohio. Catalog describing universal adjustable blade shell, hand and machine reamers. Illustrated, 6x9, pp. 35, paper.

Westinghouse, Church, Kerr & Co., 10 Bridge street, New York. Catalog, entitled "Work Done," which gives brief descriptions of a number of plants installed by this company. Illustratd, 6x9, pp. 75, paper.

The Tuttle & Bailey Manufacturing Company, 83 North Tenth street, Brooklyn, N. Y., would be pleased to receive catalogs of metal and wood-working machinery, foundry appliances and general supplies, these to be addressed to Dept. G.

Robins Conveying Belt Company, Park Row Building, New York. Bulletin No. 14, illustrating and describing conveying and elevating machinery for handling sand, stone, cement, concrete, concrete materials and excavated earth and rock. 6x9, pp. 23, paper.

Wm. B. Scaife & Sons Co., 221 First avenue, Pittsburg, Pa. Folder containing a reproduction of two pages of the ledger of a manufacturing concern showing the cost of operating a 2000-h.p. boiler with and without a water-softening and purifying system.

The Yale & Towne Manufacturing Company, 9-15 Murray street, New York. Catalog describing electric hoists made by this company. This is well printed and contains fine half-tone engravings showing various applications of the hoists. 6x9, pp. 24, paper.

The Electric Controller and Supply Company, Cleveland, O. Bulletin No. 101, on the Dinkey ventilated controllers. Illustrated, 5x7½, paper. Bulletin No. 102, on Type U

controllers. Illustrated, 5x7½, paper. These bulletins are very comprehensive, containing instructions for ordering and other detailed information.

Wilhelmi, Hall & Co., 93 Reade St., New York. Wilhelmi-Hall Price Current. This is the first number of a publication to be issued monthly and applies to the catalogs of manufacturers whose interests this company represents in and about New York City. The company has adopted a new plan of exchanging all prices so that a uniform discount can be quoted on all lines.

Star Corundum Wheel Co., Ltd., 224-238 Twenty-first St., Detroit, Mich. Catalog No. 8, describing emery and corundum wheels, grinding machinery and sharpening devices. This contains rules for calculating speeds and diameters of pulleys, tables and other information which ought to be useful to those interested. Copy will be mailed to anyone on request to the company. Illustrated, 6x9, pp. 101, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machines designed and built. Geo. M. Mayer, M. E., 1131 Monadnock Bl., Chicago, Ill.

Special machinery accurately built. Screw-machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Trained men are in constant demand at high salaries. Our seven weeks' course fits you to drive, maintain and repair all gasolene cars. Day and evening classes. Inspection of building solicited. New York School of Automobile Engineers, 146 West Fifty-sixth street, New York.

Tool catalog No. 22, 950 pages, bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

For Sale.

For Sale—Foundry, wood and iron machine shops, Albion, N. Y. Box 74.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AMERICAN MACHINIST.

For Sale—Second-hand 20x24 Atlas engine, heavy duty, automatic type, right hand with 9'x26" band wheel, speed 160 r.p.m. In good condition. Address Box 1, Columbus, Ohio.

For Sale—Controlling interest in factory manufacturing automobile accessories, near New York City. Well-established trade, large amount of orders on hand, making good profits. Best reason for selling. Box 601, AMERICAN MACHINIST.

Business Opportunities.

A good opportunity for someone to buy a machine shop and foundry for only $3000, located in Central Missouri. J. W. Fischer, Fayette, Missouri.

Wanted—A manufacturer to build machines in the printing line in lots from six to twelve. State full particulars, location, etc. Box 546, AMERICAN MACHINIST.

Mechanical engineer wants to obtain business relations with reliable concerns who would like to be advertised and represented in Europe. Send particulars, catalogs, etc. Box 593, AMERICAN MACHINIST.

Wanted—Builders for an automatic screw machine; time-tried and thoroughly proven; up to date and very rapid; parties must have capital and an up-to-date equipment. A. Z., Box 588, AMERICAN MACHINIST.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MARYLAND.

Mechanical engineer with extensive experience on explosion engines, desires position at chief draftsman. Box 600, AMER. MACH.

MICHIGAN.

Position by mechanical engineer and superintendent; 25 years' practical experience in above capacity in up-to-date methods of production and cost systems in foundry, machine shop, forging, hot and cold pressed and cold-drawing work, structural and sheet-metal construction, steam, water, gasolene and industrial railway installations; references. Box 570 AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman wishes position. Address Box 594, AMERICAN MACHINIST.

Draftsman, 29, technical graduate, mechanical, some electrical, 6 years drafting, 6 years shop experience, desires change, in or near New York preferred. Box 599, AM. M.

Machinist and toolmaker, German, 32 years, 15 years' experience all-around mechanic building automatic machinery, jig, tools and experimental work. Steady worker wishes to change. Box 566, AMER. MACH.

Engineer desires change; where now employed has charge of drafting room, shops, power plant, construction and maintenance and purchasing department; thorough practical training in all branches. Box 580, AM. M.

NEW YORK.

Machinist and die-maker, age 34, wants position in New York or Brooklyn. Box 581, AMERICAN MACHINIST.

By machinist tool maker, 20 years' experience, speak English, German, first class references; can take charge of tool room. Box 576, AMERICAN MACHINIST.

Production engineer, purchasing agent, cost accountant, familiar with premium system, 10 years' experience, good systematizer, desires position. Box 598, AMER. MACHINIST.

Marine shop or dry dock superintending and consulting engineer with good connections would take interest and build up business. Address Enterprise, 592, AMER. MACH.

Practical automobile machinist, open after June 1, would drive and care for private car, or take charge of small garage. Reliable, with proven ability. Motor 571, AMERICAN MACHINIST.

Position as superintendent or general foreman in plant manufacturing steam, marine, gas or gasolene engines; general mill machinery; fine grade automatic machinery. Box 462, AMERICAN MACHINIST.

General foreman, taking entire charge of machine shop or manufacturing plant, successful in producing first-class work at satisfactory cost, varied experience, practical mechanic, desires change. Box 482, AM. MACH.

Mechanical engineer or chief draftsman: practical experience on power printing machinery, gas, gasolene and kerosene-oil engines, hydraulic and mining machinery; familiar with modern shop methods. Address Box 590, AMERICAN MACHINIST.

A young machinist of three years' experience, having been imprisoned for a year, wants to start anew. Will give faithful, earnest, honest service to any machine-shop owner who will give him an opportunity. Box 585, AMERICAN MACHINIST.

Position as superintendent or general foreman; successful experience in both capacities; good executive, and will guarantee results from a personal investigation of plant and conditions. Best of references from present and past employers. Box 582, AMER. MACH.

A business woman of experience wants a position as advertising manager of a manufacturing concern in Eastern territory. Has had charge in two large concerns and refers to both. Capable of writing all ads, booklets, catalogs, etc.; familiar with all details of printing and illustrating. Box 542, AM. M.

OHIO.

Wanted—Position as detail draftsman. Age 22. Two years' experience on general machinery. Good references. Box 574, AM. M.

Mechanical engineer, 37, thorough, practical experience in shops and drafting room, technical, executive ability and commercial training, desires correspondence with firms having prospective openings. Box 522, AM. M.

Wanted—Position as superintendent, or works manager by energetic young man, holding responsible position with concern in which he owns stock, desires change. First-class references given and required. Box 572, AMERICAN MACHINIST.

PENNSYLVANIA.

Young man (31) technically educated, machinist by trade, desires position in foundry and machine shop. Will invest $5000 in business at end of two years. Box 589, AM. M.

Designing draftsman and shop foreman (30), technical graduate, experience hoisting-excavating machineries, gas-steam-engines, also structural work, desires position. Box 569, AMERICAN MACHINIST.

FOREIGN.

Foreign trade (machine toolmakers) Englishman (35, unmarried), with wide European experience, desires berth with first-class firm; good accountant, correspondent, and well up in factory costs; first-class salesman, thoroughly acquainted with all European and foreign buyers; first-class references; moderate salary. Address Box 999, AMERICAN MACHINIST, 6, Bouverie street, London, England.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Competent toolmakers for gage and fixture work. Write fully as regards experience and wages expected. Apply Ross Rifle Company, Quebec, Canada.

Wanted—Draftsmen experienced on fixtures and dies for light interchangeable work. Address, giving details of experience and expectations, Box 514, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

ILLINOIS.

Required for a small arms factory abroad, an educated engineer with experience of very high-class interchangeable work produced by the latest automatic and repetition methods. Must be active, energetic, thoroughly at home in jig and fixing work and up to date generally. Write fully as regards experience and salary expected, also stating age, etc. Box 520, AMERICAN MACHINIST.

KENTUCKY.

Wanted—Foreman for stamping department of sheet-metal works. Write for particulars, stating age, experience and references. Box 539, AMERICAN MACHINIST.

MASSACHUSETTS.

Architectural draftsmen wanted, who are familiar with mill construction. Vicinity of Boston. State age, experience and salary expected. Box 579, AMERICAN MACHINIST.

Wanted—At once, several jig makers and scraper hands. We can offer good wages and permanent positions to the right men. Apply Campbell Printing Press Mfg. Co., Taunton, Mass.

MICHIGAN.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center, and is one of the finest cities in this country. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern up-to-date methods. Competent men who are experienced and will "do things right" can secure permanent employment at first-class wages. State

age, experience, references, wages, and give full information. Cadillac Motor Car Co., Detroit, Mich.

MINNESOTA.

Wanted—First-class machinists, moulders and pattern-makers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address with references, Minneapolis Steel & Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Head machinist in small shop; all classes of work. E. C., Box 568, AMER. MACHINIST.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Foundry foreman wanted in open shop. Give reference, experience, and state salary expected. Box 583, AMERICAN MACHINIST.

Wanted—Foreman with experience in erecting high-speed automatic engines. Reply, stating experience and pay expected. Box 587, AMERICAN MACHINIST.

Wanted—Lathe and vise men. Positions permanent to competent men. Open shop. Within 45 minutes of New York City. Box 194, AMERICAN MACHINIST.

Wanted—First-class mechanical draftsman for a large concern in the vicinity of New York City. Give age, experience, reference and salary expected. Box 577, AMER. MACH.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—A first-class designer on tools for production of interchangeable parts of small and medium size machinery. Must be capable of looking after several other draftsmen. State age, experience, references, and salary expected. Address reply to Box 547, AM. M.

Wanted—A large number of first-class die and toolmakers on high-grade work. Only men of recognized ability need apply. First-class wages and steady employment to competent men. See our notice of removal on page 86 of this issue. Sloan & Chace Mfg. Co, Ltd., Newark, N. J.

NEW YORK.

Wanted—First-class pattern-maker; state experience and full particulars. Box 586, AMERICAN MACHINIST.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

First-class mechanical draftsmen desired; state age, experience and salary expected. Box 507, AMERICAN MACHINIST.

Wanted—Several first-class all-around machinists; give age, experience in detail, and wages expected. Box 596, AMER. MACHINLST.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Foreman for assembling department; must be a man of ability and furnish A-1 references. Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Chief draftsman of wide experience on web printing presses. Excellent opportunity. State age, experience, and salary desired. All communications held strictly confidential. Box 476, AMER. MACHINIST

Bill clerk, familiar with keeping stock records and general office work, wanted; experience in steel, iron or machinery lines preferred; to receive attention state age, experience, and wages expected. Box 591, AM. M.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hours work day; time and a half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

Successful superintendent of experience in the manufacture of small parts for a complicated machine, capable of handling men and carrying on systematic, orderly and economical production. Address System, Box 584, AMERICAN MACHINIST.

Wanted—A young man of sound education and technical training to teach mechanical drawing and similar academic subjects, and to assist the superintendent, in a trade school. Must speak German. Address, giving full particulars, J. Ernest G. Yalden, 222 East Sixty-fourth street.

OHIO.

Wanted—Experienced foreman for screw department of manufacturing concern. Box 575, AMERICAN MACHINIST.

Foreman wanted for a machine shop operating small and medium-size tools. State age, experience and salary. Box 595, AM. MACH.

Wanted—A first-class machine draftsman for automobile work, one who has had considerable experience in this class of work desired. Address "Machine Draftsman," Box 538, AMERICAN MACHINIST.

Wanted—First-class gas-engine designer, one having experience in designing four-cylinder automobile engines, by one of the largest automobile manufacturers in this country. Address "Engine Man," AMERICAN MACHINIST.

The National Metal Trades Association can place a few first-class wood pattern-makers, tool-makers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, O.

PENNSYLVANIA.

Wanted—Draftsmen with technical education; experienced in hydraulic machine design. Box 567, AMERICAN MACHINIST.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 578, AMERICAN MACHINIST.

Foreman, experienced in all branches of gear cutting, to take full charge of twenty-six machines. Box 513, AMERICAN MACHINIST.

Wanted—Fifty first-class toolmakers or machinists; good wages to right parties; no labor troubles. Driggs-Seabury Ordnance Corporation, Sharon, Pa.

Wanted—Ten lathe hands for night turn, also pattern-maker, day time. Write, giving experience and wages expected. Wilson Laundry Machine Company, Columbia, Pa.

Wanted—Experienced machinist, capable of taking charge as foreman of shop on valves and fittings. In reply state age, where employed at present, and experience in detail. Good opportunity for the right man. Box 573, AMERICAN MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: character, common sense, experience with automatic machinery, (or) printing office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers Wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Unusual opportunity for a man with mechanical ability to work into a position of responsibility. Must be energetic, tactful and a good executive, capable of handling men, and a good machinist. Plant located in Wisconsin. Reply, giving full experience, present occupation, and salary desired. Box 509, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—A first-class foreman for plant manufacturing gasolene engines and air compressors. Good opening to a man of executive ability. State age, experience, reference and salary expected. Box 597, AM. MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	115
Acme Machinery Co.	34
Adams Co.	9
Advance Mfg. Co.	115
Albro-Clem Elevator Co.	117
Alliance Machine Co.	110
Almond Mfg. Co., T. R.	120
Alteneder & Sons, Theo.	34
American Gas Furnace Co.	14
American Pulley Co.	85
American Tool Works Co.	8
American Tube and Stamping Co.	123
American Watch Tool Co.	119
Armstrong Bros. Tool Co.,	98 and 110
Athol Machine Co.	104
Auburn Ball Bearing Co.	108
Audel & Co., Theo.	110
Automatic Machine Co.	95
Backus Water Motor Co.	102
Baker Bros.	101
Baker Machine Corp.	95
Baird Machinery Co.	91
Baldwin Chain & Mfg. Co.	92
Baldwin Steel Co.	83
Barnes Co., B. F.	115
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E.	99
Bath Grinder Co.	89
Baush Machine Tool Co.	88
Bay State Stamping Co.	93
Bay State Tap & Die Co.	117
Bay State Tool Co.	24
Beaman & Smith Co.	15 and 120
Becker-Brainard Milling Machine Co.	23
Bell Electric & Mfg. Co.	96
Bemis & Call Hardware & Tool Co.	121
Bertram & Sons Co., John	27
Besly & Co., Chas. H.	24
Bethlehem Fdry. & Mach. Co.	93
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	98
Bilgram, Hugo	34
Billings & Spencer Co.	100
Binsse Mach. Co.	34
Birdsboro Steel Fdry. & Mach. Co.	75
Blaisdell Machinery Co.	122
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	119
Boker & Co., Hermann	81
Boston Gear Works	116
Boynton & Plummer	85
Bowers, E. J.	105
Bradford Machine Tool Co.	5
Bridgeport Safety Emery Co.	118
Bristol Co.	4th cover
Brown-Cochran Co.	102
Brown Co., H. B.	92
Brown & Co., R. H.	120
Brown Hoisting Machine Co.	111
Brown & Sharpe Manufacturing Co.	4th cover and 71
Buckeye Engine Co.	97
Buffalo Forge Co.	4th cover and 86
Builders Iron Fdry.	3d cover
Bullard Machine Tool Co.	32
Bury Compressor Co.	122
Butler, A. G.	104
Calculagraph Co.	115
Caldwell & Son Co., H. W.	111
Carborundum Co.	26
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	95
Case Mfg. Co.	111
C & C Electric Co.	106
Chambersburg Eng. Co.	98
Champion Tool Works	114
Chandler & Farquhar Co.	92
Chadwick & Co., G. B.	121
Chattanooga Machinery Co.	105
Chicago Flexible Shaft Co.	29
Chicago Rawhide Mfg. Co.	116
Chisholm & Moore Mfg. Co.	110
Cincinnati Electrical Tool Co.	110
Cincinnati Machine Tool Co.	25
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	126
Clark Cast Steel Cement Co.	124
Clayton Air Compressor Wks.	122
Cleveland Automatic Mach. Co	18
Cleveland Cap Screw Co.	114
Cleveland Crane & Car Co.	110
Cleveland Twist Drill Co.,	4th cover
Cleveland Wire Spring Co.	109
Clough, R. M.	110 and 117
Coates Clipper Mfg Co.	108
Coes Wrench Co.	33
Colburn Machine Tool Co.	22
Columbus Machine Co.	102
Cook Co., Asa S.	104
Crescent Forgings Co.	101
Cresson Co., Geo V.	121
Crocker-Wheeler Co.	109
Crosby Steam Gage & Valve Mfg. Co.	17
Cumberland Steel Co.	95
Curtis & Co. Mfg. Co.	122
Curtis & Curtis Co.	124
Cushman Chuck Co.	120
Davis, Rodney	116
Davis Machine Co., W. P.	90
Desmond-Stephan Mfg. Co.	118
Detrick & Harvey Mfg. Co.	105
Dexter, Chas. S.	96
Diamond Machine Co.	3d cover
Dickinson, Thos. L.	95
Diehl Mfg. Co.	108
Dill Machine Works, T. C.,	27 and 90
Dixon Crucible Co., Joseph	99
Dodge & Day	93
Dreses Machine Tool Co.	89
Drucklieb, C.	122
Durbrow & Hearne Mfg. Co.	108
Dwight Slate Machine Co.	95
Earle Gear & Mach. Co.	117
Eastern Machinery Co.	121
Eberhardt Bros. Mach. Co.	114
Eck Dynamo & Motor Works.	108
Elliott Chemical Works.	96
Elmira Machine Works.	96
Emmert Mfg. Co.	104
Equipoise Rivet Co.	96
Errington, F. A.	121
Evans Friction Cone Co.	97
Excelsior Needle Co.	124
Fairbanks Co.	91
Farrel Fdry. & Mach. Co.	124
Fawcus Machine Co.	1
Fellows Gear Shaper Co.	116
Felton, Sibley & Co.	96
Fenn-Sadler Machine Co.	104
Firth-Sterling Steel Co.	125

The National Bureau of Standards at Washington—II.

THE PHYSICAL LABORATORY BUILDING.

The Physical Building, general views and plans of which are given in Figs. 1 to 6, is 172 ft. long, 55 ft. wide and four stories high, besides the partial basement and a spacious attic. The south facade, through which it is intended the main entrance to the Bureau shall ultimately be, commands a fine view of the City of Washington. The entrance hall leads into a large staircase hall, at one side of which is the elevator, and which is intersected by a corridor running the whole length of the building, so that when the additional buildings at the east and west, referred to in the beginning, have been constructed, it will be possible to extend this corridor in the form of an arcade so as to connect with the new buildings. The basement is excavated only under the central portion of the building, and under the corridor. The four rooms at the ends of the ground floor have concrete floors resting on the ground, covered by a substantial flooring of oak blocks. This gives a firm support for tables, apparatus, or even temporary piers, if necessary.

Instead of building up permanent piers through the floor, as is often done, the entire building is so substantial and free from vibration that the most delicate apparatus can be mounted on brackets or shelves attached to the walls of buildings. In one of the basement rooms a subdivided storage battery has been installed for use in this building. Six other rooms of the basement will be used as constant-temperature rooms as they may be needed. It is intended to have here a clock-room as the permanent location of the standard clock.

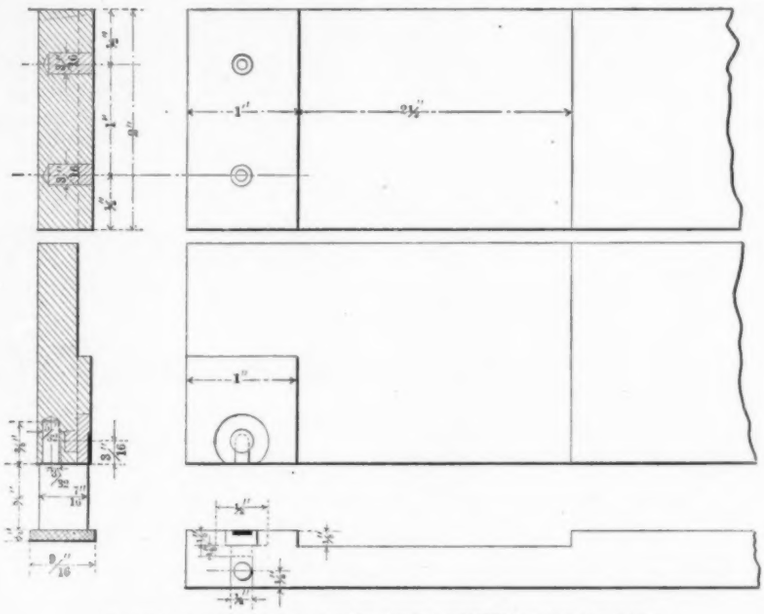


FIG. 25. PORTIONS OF THE 50-METER BENCH-STANDARD BARS.

The entire first and second floors are given up to laboratory work. In order that the changes in temperature may be a minimum, double windows have been provided, and automatic temperature control secured by means of thermostatic dampers, controlling the supply of hot and tempered air. This, of course, regulates the temperature only in winter, or in cool weather; in summer the temperature is controlled in some rooms where necessary by means of brine coils, as explained under "Mechanical Building."

Between rooms Nos. 101 and 102, next to the outer wall, is a vertical shaft three feet square, extending from the basement to the attic, and in corresponding positions in the other three quarters of the building there are three similar shafts. All the pipes for distributing hot and cold water, ice water, cold brine, gas, compressed air, vacuum, and all electric wiring for lighting and experimental purposes are carried up through these shafts. A door opens into each shaft on each floor, making all main pipes and wires accessible without having them exposed in the laboratories. On each floor branches are brought out from the water and waste pipes to the sinks, from the air and gas pipes to the work tables, from the brine pipes to any cold boxes or other apparatus requiring it, and from the distributing wires in the shafts to the small local switchboards, of which there is one for each suite of laboratory rooms in the building. The wires connected to these small switchboards run to a main switchboard near the north door of the first floor, and thence trunk lines run through the tunnel connecting the two buildings (Fig. 13) to the main distributing switchboard of the dynamo room. Thus through these two main switchboards and the local laboratory board any circuit in any laboratory room may be joined to any circuit of any other laboratory room, or to any battery or generator in the mechanical building. By means of a subdivided battery wired to the switchboard and an auto-transformer at the switchboard, any direct or alternating electromotive force less than the regular line potential (120 and 240) can at any

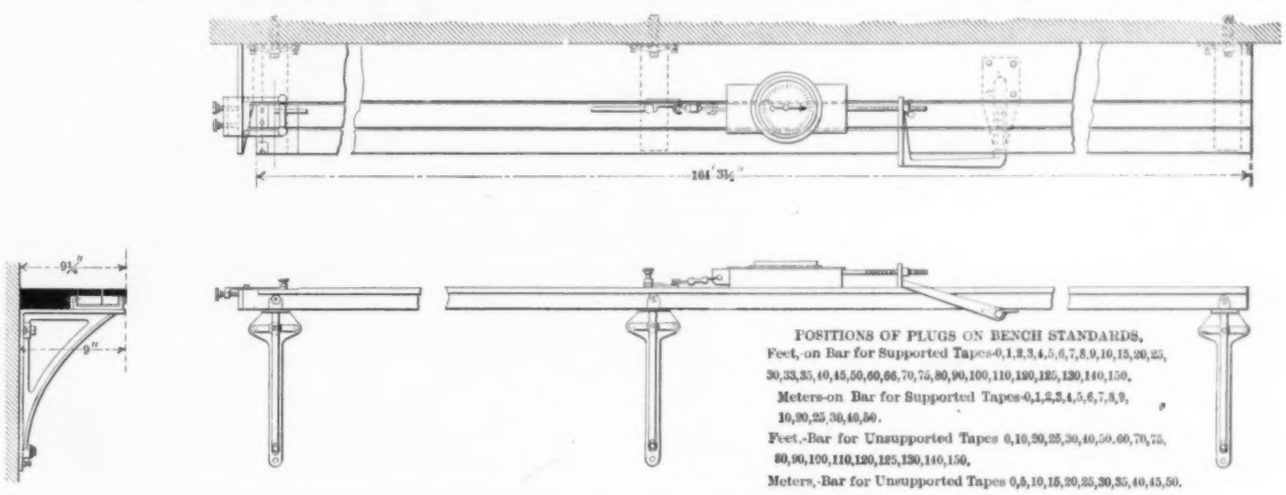


FIG. 26. 50-METER AND 150-FOOT BENCH STANDARDS, FOR SUPPORTED AND SUSPENDED TAPES.

time be obtained. Great pains have been taken to equip every laboratory with the conveniences necessary for the most efficient work.

DETAILS OF THE SECTIONS IN THE PHYSICAL BUILDING.

The weights and measures section has its headquarters in this building, and before proceeding to a description of some of the apparatus used in this section it will be well to give a general idea of its duties. They include the comparison of standards of lengths, mass, and volume, with the official standards of the United States, all of which are in the custody of the bureau. These measures are submitted by the Government departments, by State and city inspectors of weights and measures, by manufacturers, and by scientific and technical institutions and individuals. In cases where there are no local inspectors the Bureau tests and seals commercial weights and measures, provided they conform with certain essential requirements as to construction. This section also gathers information as to the laws and usage of local and foreign weights and measures, and when such information is sufficiently important it is published by the Bureau. In 1904, a quarto volume of nearly 500 pages was published; it is a compilation by L. A. Fischer, associate physicist, and H. D. Hubbard, secretary, of the laws of the United States and of the States concerning weights and measures, and shows great diversity of these laws. On January 16 and 17, 1905, a meeting of the State sealers of weights and measures was held at the Bureau of Standards for the purpose of discussing the means for securing uniform laws and inspection of commercial weights and measures throughout the United States.

In addition to the verification of weights and measures, this section tests

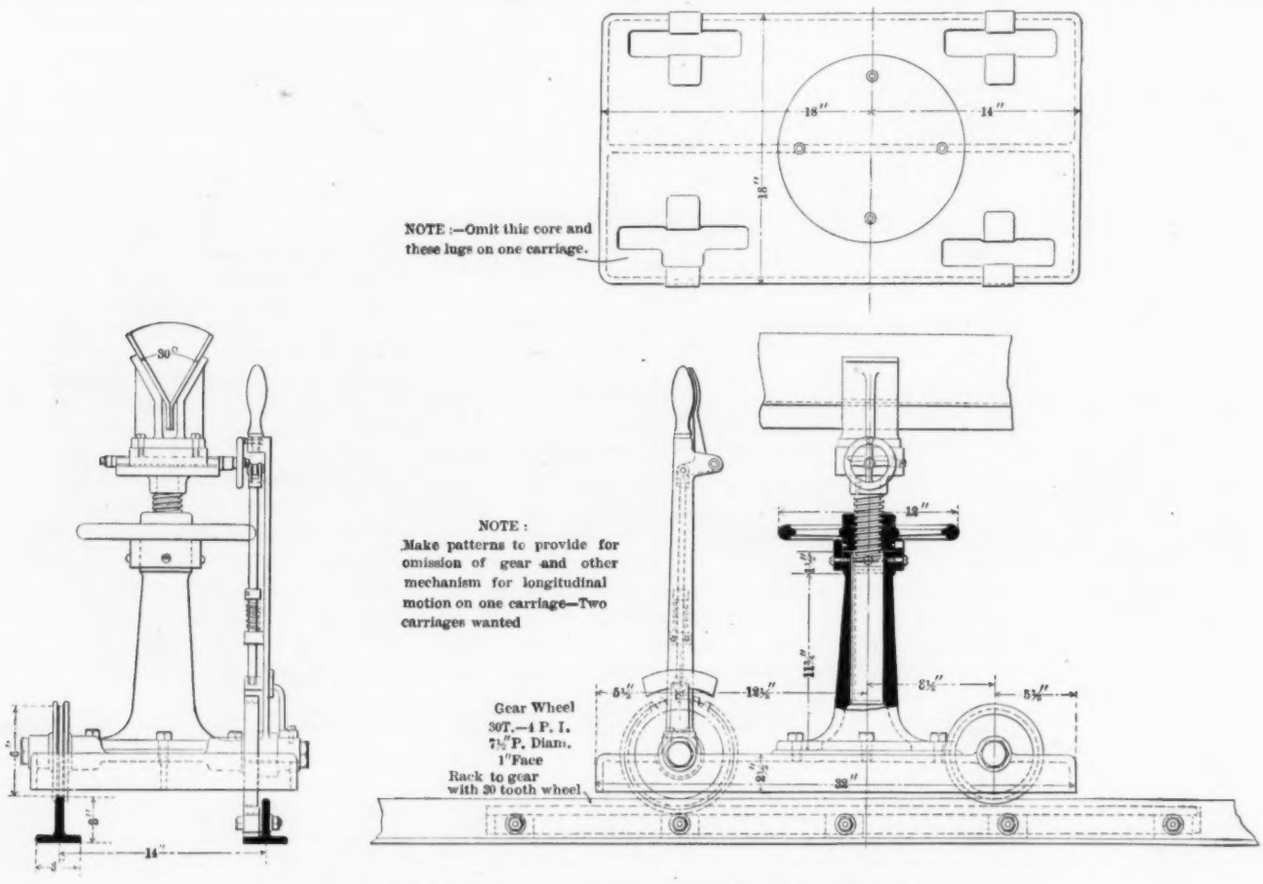


FIG. 27. CARRIAGE FOR ICE-BAR FOR 50-METER COMPARATOR.

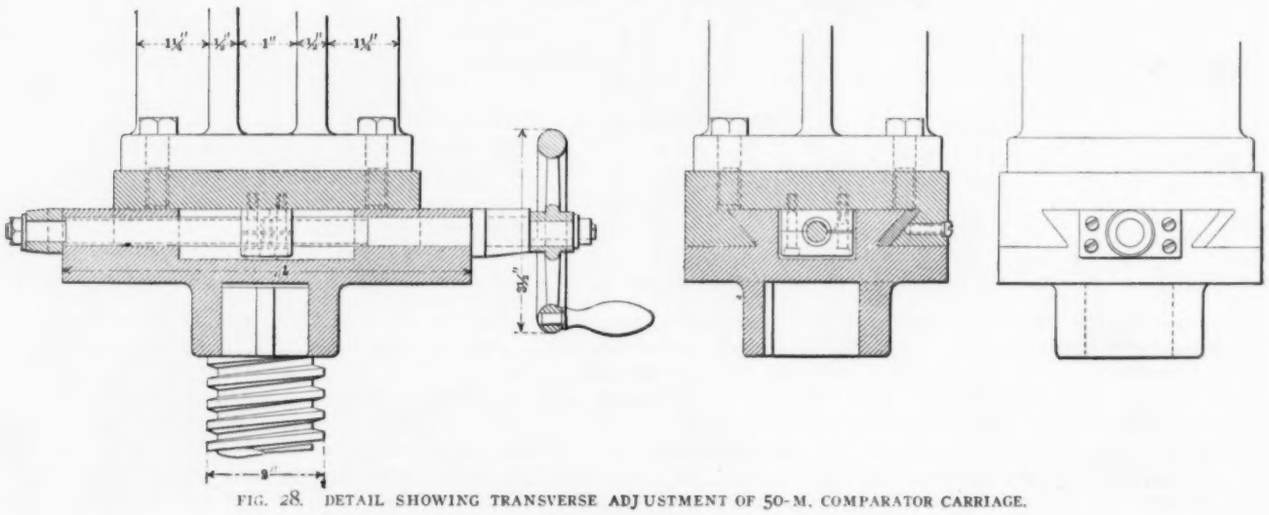


FIG. 28. DETAIL SHOWING TRANSVERSE ADJUSTMENT OF 50-M. COMPARATOR CARRIAGE.

hydrometers and aneroid barometers, and it is preparing to take up the testing of watches, chronometers and other time-measuring apparatus. The Bureau has a self-regulating clock, made by Riefler of Munich, which is mounted in a vacuum case, and is provided with a pendulum of invar, of which the co-efficient of expansion at ordinary temperatures is so small as to be practically negligible. From the Naval Observatory every day at noon, *via* the Washington Navy Yard, signals are received by wireless telegraphy, which insures the keeping of standard time. The variation is usually not greater than one-tenth of a second per diem.

THE 50-METER COMPARATORS.

We will, as before, start with the base-

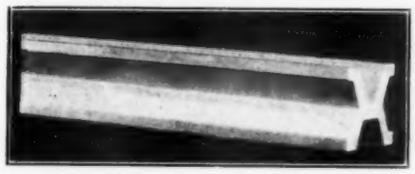


FIG. 29. THE UNITED STATES PROTOTYPE METER.

ment and take up first the tunnel containing the 50-meter comparators already referred to, and of which a plan and section are given in Fig. 13. This apparatus has been in course of construction for some time but it is not yet quite completed. Its object is to provide for performing one of the important duties of the Bureau, namely, the standardizing and certification of geodetic base apparatus and surveyors' steel tapes, which is a matter of the highest practical importance, as is very evident, since the laying out of lands and cities depends thereon, and in the past much error has been produced by reason of the employment of tapes which were not accurate. At the beginning of the Bureau's existence, when it occupied temporary quarters, this work was done on an improvised bench which was located outdoors, the tapes to be tested being under a standard strain, allowance being made for temperature variation by using carefully tested thermometers. With the new equipment, however, it will be possible to do all this work at a constant standard temperature, because of the perfect arrangements made for ventilation, heating and cooling, already described.

The subway, as shown in the section in Fig. 13, consists of three divisions, an upper one containing the ducts for hot air and tempered or cold air, and also the return air circulation, and below on one side is a smaller passageway for persons walking between the buildings, and around on the walls and ceiling of which are supported the various water, steam and gas pipes, etc., and the electric wires connecting the physical and mechanical buildings. Alongside of this passage, and separated from it by a wall, is the tunnel in which the measuring appliances are located, its width being 7 ft. 4 in. One of the 50-meter comparators is to be similar to the bench standard heretofore used and will consist of a continuous steel bar 50 millimeters by 13 millimeters in cross section. This bar will

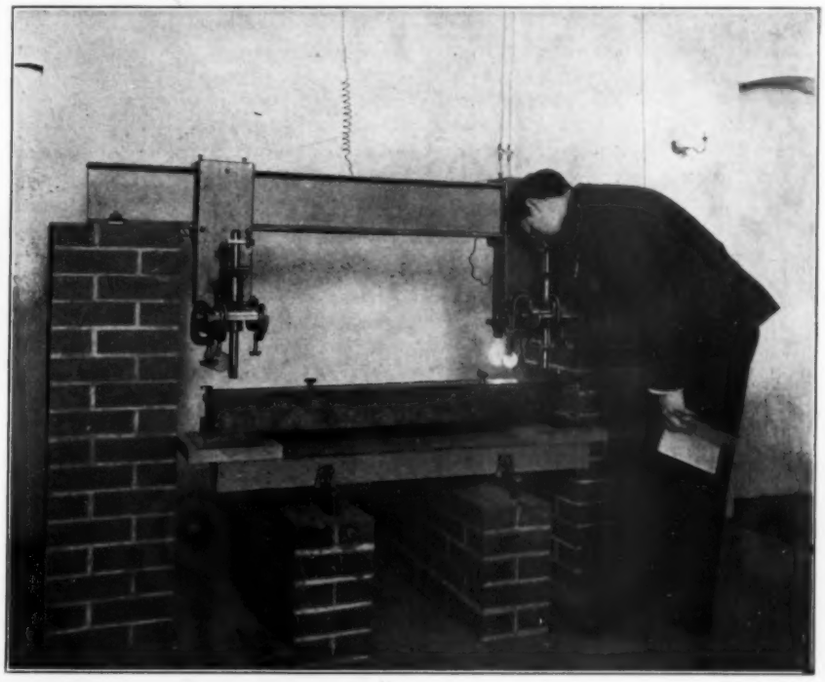


FIG. 30. METER COMPARATOR.

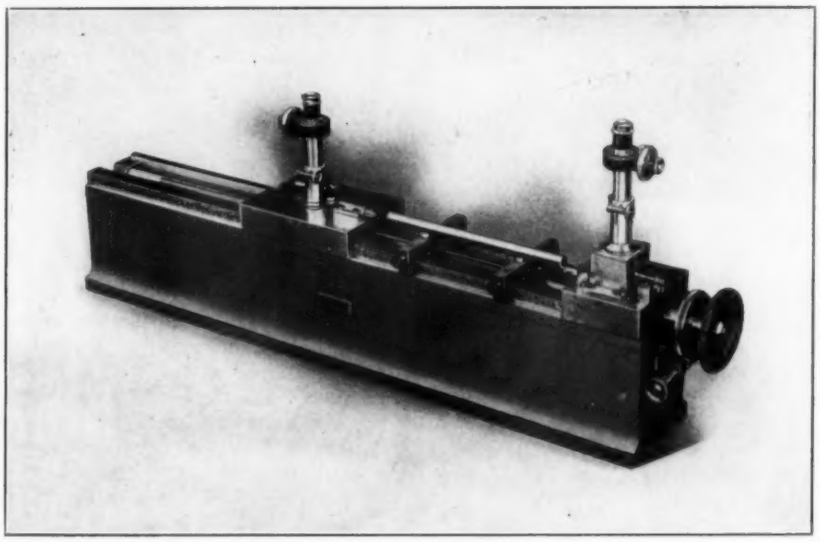


FIG. 31. FOUR-DECIMETER COMPARATOR BUILT IN THE INSTRUMENT SHOP.

be mounted on rollers one meter apart, the rollers being in turn mounted on cast-iron brackets, fastened to the wall of the tunnel. The graduations on the 50-meter bar will be made on small platinum-iridium disks, which will be inserted in the surfaces of the bar. The 50-meter comparator for geodetic base bars and for tapes used for geodetic work is partly completed. The stone piers, five meters apart (indicated in the cross-section in Fig. 13), on which are the microscopes used in observing the lines on the 5-meter standard, have been placed in position, and between one pair of piers four other piers have been placed one meter apart for the purpose of "building up" the 5-meter bar from the national prototype meter. In Fig. 25 are given cross sections and a portion of a plan of these bars, and in Fig. 26 is given an assembly showing the method of supporting them upon the brackets, and also the dynamometer for putting a uniform tension upon the tape which is being compared with the standard bar. Tapes will be measured in two ways, by supporting them along the bar, and by allowing them to be suspended from the ends. The long bars are made by welding bars of steel together in the tunnel by the use of thermit, so as to form a continuous strip. First of all, a

5-meter bar is built up by comparison with a standard 1-meter bar, and from the 5-meter bar the 50-meter bar is in turn graduated. The preparations for doing this work are quite elaborate, as the highest accuracy is necessary to avoid the accumulation of error which might occur in forming a 50-meter bar starting from a 1-meter bar. The shorter bar used in making the comparison is mounted upon two carriages (one of which is shown in Fig. 27), which run along a track laid the whole length of the tunnel. It will be noticed that this carriage or truck is provided with a lever, the latch of which engages with the teeth of a gear wheel on the axle of one of the carriage wheels, of which there are only three, in order to insure a solid bearing. The length of this lever, compared with the diameter of the wheel, enables a very accurate adjustment of the endwise position of the truck to be obtained. Leveling of the bar is provided for by the elevating screw shown, and transverse adjustment by means of a hand wheel and screw (Fig. 28) at the top of the elevating screw. By the use of these carriages and the microscopes mounted on the piers, it is possible to move the short bar successively along the long bar until all the divisions have been accurately laid off on the latter. Both metric and English graduations will be provided. When these comparators are finished it will be possible to measure 50 meters or 50 yards with a probable error not exceeding the $\frac{1}{5,000,000}$ part of the total length.

1-METER COMPARATOR.

Fig. 29 shows a portion of the prototype meter, referred to at page 50 of the present volume. As already stated, the United States standards of measurement are kept in a fireproof vault, and they are very rarely disturbed, secondary standards being used for comparison in nearly all cases. The vault in which these standards are kept is not only fireproof, but the door is closed by a combination lock which can be opened by Messrs. Stratton and Fischer only, and within the vault on a shelf sealed with glass reposes, along with a few others, the ultimate standard of length for this country—an iridium bar of H-section, having two lines 1 meter apart, in the neutral axis of the bar, upon gold plugs. This bar cannot be seen, however, for it is within a case, sealed and the seals have not been broken since it was brought from Paris in 1900 by Mr. Fischer, who took it there for comparison with the international standard. In order to compare one meter bar with another, it is necessary to have a very accurate comparator. The Bureau has in the basement of this building a room set aside for this purpose. Fig. 30 is a picture of the apparatus, taken, however, before it was placed on its present mounting. In place of the brick piers shown in the picture, the apparatus is now supported on concrete piers; as can be seen it consists of a means of supporting the two bars under examination, and of independently supporting a microscope at each end in order to examine the relation of the graduations on the two bars. It would be a revelation to many people to see all the precautions which are taken in making such a comparison. The bars are placed in a long box, and are surrounded by packed ice, and this in turn in another box, and so on, so that it will be absolutely certain that they are both at the same temperature and are protected from surrounding thermal influences. The room itself is of course closed up, and its temperature regulated by means of the facilities already described. With the microscopes mounted on a beam in this manner it is possible to change their position and thus use the comparator for measuring not only a distance of one meter, but also a yard or any length down to one decimeter. It is the intention to substitute for this beam one made of invar, so that the microscopes will be as stable as if mounted on independent piers. This metal, which is a non-expanding nickel-steel having an approximate composition of 64 per cent. Fe, 35 per cent. Ni, and the remaining 1 per cent. made up of C, Si, Mn, etc., has been found very valuable in scientific work.

THE FIRST FLOOR.

On the first floor of the physical laboratory (Fig. 3) is a room containing several length comparators. Fig. 31 is a picture of one of these, which was built in the instrument shop, according to plans prepared by the Bureau, and which has a capacity of four decimeters. It is found to be very satisfactory, and it is believed that it will enable the determination of the length of end gages and standards with greater accuracy than has heretofore been obtained.

Fig. 32 is a picture of the Geneva dividing engine, used in the construction of secondary linear standards. This machine in its movements is mechanically the equivalent of a shaper, with the addition that the tool is raised and lowered so that its movement is very similar to that of a pencil or scriber held in the hand. The corrections for the minute inaccuracies of the lead screw are made by a longitudinal cam. The machine can be arranged to work automatically. If desired the amount of motion between graduations can be determined by mounting a standard scale, as well as the new bar, on the carriage, and getting the graduations on the former successively beneath the cross-hair of the microscope, a line being engraved on the new scale at each point. The travel of the carriage is one-half meter, the tool travel is 1 centimeter, and the instrument is capable of drawing lines with a minimum spacing of five microns (0.005 millimeter = 0.000197 inch).

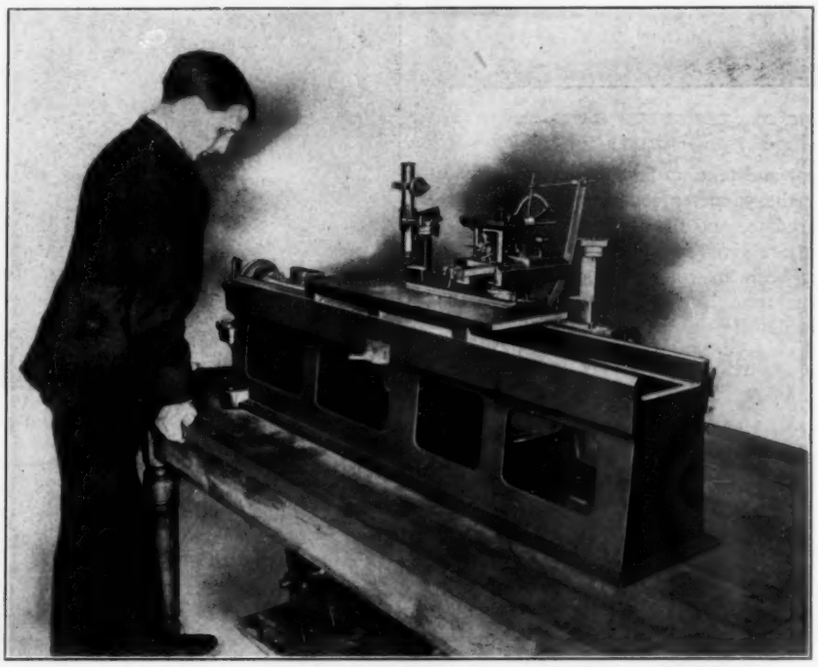


FIG. 32. GENEVA DIVIDING ENGINE.

In the northwest corner of this floor is a room containing a complete series of the very best precision balances, duplicates of which will be found only in the standardizing laboratories of a few of the first-class countries. All mass comparisons are referred to the international kilogram, two copies of which are in the possession of the bureau. Like the meters, they are made of platinum-iridium. Fig. 33 illustrates one of the prototype kilograms, being the No. 20 referred to at page 50.

In the northeast corner of this floor is the department of heat and pyrometry, (Fig. 34) where is done the testing of pyrometers used in industrial and scientific work, the determination of the calorific values of fuels, the flash point, viscosity, and freezing points of oils, the specific heats and melting points of metals and alloys, the determination of thermal constants of widespread interest in scientific and technical work, e.g., the specific heat of brine, the conductivity of materials used in refrigeration industries and building materials, the determination of fixed points of reference, like the melting point of platinum used as fixed points in high temperature measurement, and a special investigation of optical pyrometers, a type of instrument which by reason of its capacity for measuring the very highest temperatures, the fact that contact with the hot body is not necessary, and the uniform results which can be obtained by its use, promises to be of very great practical importance in various industrial processes. Anyone interested in this subject will find in the Bulletin of the Bureau a very complete analytical and descriptive article upon it. An instrument of this type, the Féry radiation pyrometer, was illustrated and described in the AMERICAN MACHINIST at page 668, Vol. 28, Part 2.

One quarter of this floor contains some of the rooms of the optical section. The work of this section is chiefly related to the determination of physical laws and constants, nevertheless considerable testing has been done, especially in connection with polariscopic apparatus and standards. The section has already a large collection of photographic negatives of spectra of various materials under different conditions, for example, gases and vapors of different metals contained in closed tubes, through which an electric discharge is passed. The machinist, of course, will not find any connection between this work and his own, but it is nevertheless, very pretty and very interesting; the following is an unusual piece of apparatus employed in part on this work: It is not often that one hears of a continuous-current generator developing an electromotive force of 5000 volts; the Bureau has, however, a generating set capable of this pressure which was rigged up by Dr. P. G. Nutting, associate physicist. Being set on a heavy oak table, mounted on casters, it can readily be placed so as to be under the eye of the person using the current. With this generator set, it becomes unnecessary to use batteries of storage cells for all kinds of vacuum tube work, or even for accurate conductivity tests. It is, however, no competitor for the small high-potential transformer for use in spectroscopic work with forks and Plücker tubes. One or two thousand volts is a sufficiently high potential for much of the work pertaining to gas conduction, while it is seldom that an e.m.f. of more than 5000 is desired. On the other hand, it is only above 8000 volts that insulation becomes troublesome, surface leakage occurring over oiled, painted or lacquered surfaces and across switches. Hence, 5000 volts was chosen as the most suitable potential, requiring no special precautions as to insulation, and yet ample for most work. Units of 500 volts were chosen as a compromise between reducing the number of machines to the least possible number on the one hand and minimizing commutator sparking and difficulties of insulation by increasing the number of machines on the other. It was therefore necessary to use

FIG. 34. HIGH-TEMPERATURE LABORATORY.

FIG. 33. THE UNITED STATES PROTOTYPE KILOGRAM.

ten generators, which are arranged in two rows of five each on the top of the table, which is 26 inches by 62 inches, and which also supports the motor which drives all the generators. The motor is a 2-h.p. General Electric type "C. A," 15 amperes, 115 volts, running at 1800 revolutions per minute, and belted by a 3-inch belt to the jack-shaft which runs below the table, from which 1-inch belts are led off to the generator armature pulleys. For the generator unit there was selected, as the most suitable, the old standard form of bipolar, shunt-wound, 500-volt, Crocker-Wheeler motor. They run at a speed of 2500 revolutions per minute and, as already stated, develop a potential of 500 volts, and are capable of a maximum current of 0.22 ampere—the output being, therefore, 110 watts apiece. The e.m.f. developed is subject to a wide variation by the use of a speed controller for the driving motor.

The laboratories are, of course, provided with air pumps and exhausting apparatus for the production of high vacua; to one who has only witnessed the production of 26 or 28 inches of vacuum in a steam-condensing plant a vessel in which the absolute pressure is but $\frac{1}{10,000,000}$ of an atmosphere would be a revelation.

Another branch of the optical work, viz., the standardization of polariscopic apparatus, is one of very great practical importance, inasmuch as it is the practice to examine sugar for assessment of the duty, by the polariscopic method. Polarizing apparatus for specially accurate measurements and a thermostat for use in connection with this apparatus have been designed and built in the instrument shop. An accurate quartz compensation polariscope has been assembled, and a number of quartz control plates, to be used as primary standards, have been obtained. One of the greatest obstacles to accurate polariscopic measurements is the lack of sources of mono-chromatic light of sufficient intensity. Sodium light, the accepted standard, is far from mono-chromatic. One of the spectral lines emitted by a quartz mercury lamp has been found to answer every requirement. Accordingly a determination of the rotation of quartz for light of this particular wave length has been undertaken. This is merely one example of the work done in this department. The Bureau is assisting the Treasury Department in attaining uniformity of sugar analysis at the different ports where sugar comes into the country, and it has been testing exchange samples from these ports, which send samples daily to each other and to the Bureau. In the laboratory can be found a great variety of specimens of sugars made and imported from various countries, from Cuba to China and the Philippine Islands.

The other three rooms on the first floor are occupied by some of the electrical work: viz., standards of resistance and electromotive force. The work of this section consists in the construction and verification of resistance standards and standards of electromotive force, the calibration of precision rheostats, Wheatstone bridges, potentiometers, and other resistance apparatus, the verification of resistance standards for current measurements, and the determination of the electrical properties of materials.

THE SECOND FLOOR.

The east end of the second floor of this building (Fig. 4) is also occupied by electrical work, the southeast corner being the section of inductance and capacity, and the northeast corner being the work on absolute measurements. This work includes the investigation of methods of measurement of inductance and capacity, the construction and testing of the Bureau's standards of inductance and capacity, the testing of capacities and inductances for the public, and the measurement of the inductances and capacities of instruments. The Bureau possesses a series of standards of inductance and capacity, the values of which have been fixed with high precision, using several different methods of measurement. Fig. 35 is a view which gives an idea of this laboratory. We will not take space to describe the apparatus herein, for this is only a small portion of the great amount of apparatus in the laboratories, and it is somewhat out of the line of the majority of our readers.

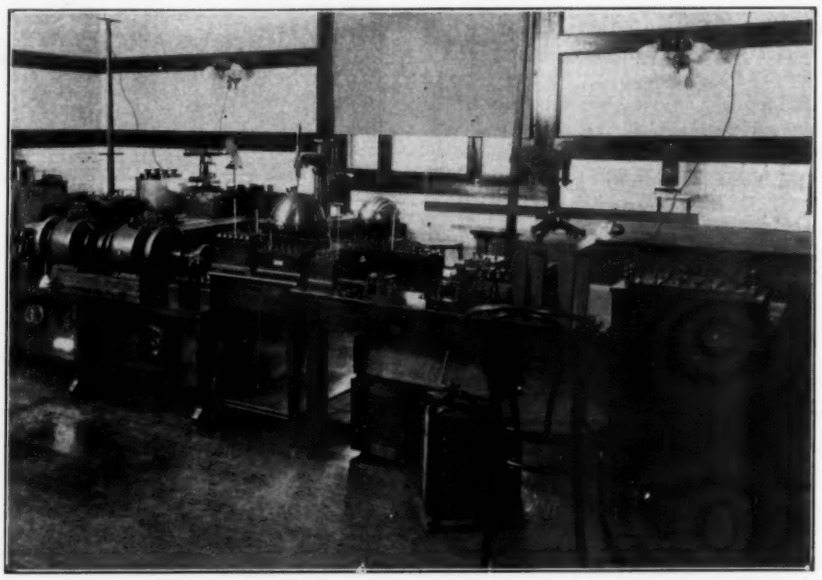


FIG. 35. LABORATORY FOR INDUCTANCE AND CAPACITY MEASUREMENTS.

The section on weights and measures also has rooms on this floor. Some of the work of this section has already been described. The work in connection with the testing of volumetric glassware has been pretty well developed. Purchasers of volumetric apparatus are now specifying that it shall conform to the regulations of the Bureau of Standards, and frequently they submit it for test. A large amount of work has been done for the Hygienic Laboratory of the Public Health and Marine Hospital Service. This laboratory has recently acquired an equipment for work in connection with diptheria antitoxins, and the testing of the potency and purity of antitoxins supplied to the public. A large part of this equipment consists of volumetric apparatus which has been submitted to the Bureau for the most careful investigation. In determining capacities of vessels, the precise measurement of small quantities of liquid is made by weighing on a very accurate balance.

THE THIRD FLOOR.

The third floor (Fig. 5), instead of being occupied by laboratories, has upon it various rooms needed for the administration of the affairs of the Bureau. It contains the directors' office, approached through a reception room, alongside of which are offices for the clerks and a file room, and at the east end of the building is the library and reading room.

The library contains considerably over 2000 bound volumes and about 1200 pamphlets, reprints and miscellaneous reports, these books being all of a purely technical character, dealing with the work of the Bureau or with subjects relative to it. The library subscribes to or exchanges with 77 scientific periodicals in this and other countries, and receives gratis many reports, translations and bulletins from similar scientific institutions, universities and learned societies. The books acquired by purchase have been, in general, books that were not available in the other libraries of the city, or were in such constant use as to require that copies be immediately at hand. The privileges of nearly all the other libraries of the city have been extended to the Bureau. A complete author and subject catalog of the works on hand has been secured, and the Bureau is also in receipt of copies of the index cards of the Library of Congress as they are

prepared, so that it possesses a complete author and subject catalog of the Library collection in the subjects relating to the work of the Bureau. In this room are kept on file all the scientific journals of this and other countries.

At the other end of the building is a lecture room, in which at frequent intervals the members of the scientific force meet together to listen to talks by the experts in each line upon the progress that is being accomplished in that line, and also to discuss the work of the Bureau in general.

THE FOURTH FLOOR: LUNCH ROOMS AND CHEMICAL LABORATORIES.

As the Bureau is at present located practically away out in the country where no restaurants are available, provision has been made on the fourth floor (Fig. 6), in the form of a kitchen and two lunch rooms, for the supplying of the members of the staff with lunch. The room at the southeast corner contains a large round table, at which the heads of the different sections meet together for their mid-day meal and are enabled to discuss anything of immediate interest at the same time.

The remainder of the fourth floor, to the extent of nine rooms, is occupied by the chemical division, which has an excellent equipment. The Bureau has undertaken to standardize some of the more important chemical reagents, and considerable work has been done in this direction. Samples of a few important materials, including limestone and steel, have been carefully analyzed with a view to their distribution when necessary, for the purpose of checking the accuracy of methods of analysis used in scientific work and in the industries. A number of substances have been examined physically and chemically for the Department of Commerce and Labor, and other departments of the Government, with a view to determining standards and standard specifications to be employed in the purchase of Government supplies. In addition to this the chemical laboratories are a very important auxiliary to the work of the other sections of the Bureau.

The largest room on this floor, namely, the one at the northwest corner, is the one occupied by the section on mercurial thermometry. In the year ending June, 1905, over 13,000 thermometers of various kinds have been tested, including precision standards, clinical standards, high temperature, maxima and minima and clinical thermometers. These include many thermometers that will be used as standards by manufacturers. The tests were made upon the international hydrogen scale of temperature, and have shown that a large percentage of the high-temperature and industrial thermometers were subject to very considerable changes with use, due to improper methods of treatment during the process of construction. The attention of thermometer manufacturers was directed to this matter by correspondence, with the result that the more recent product submitted shows a marked improvement in this respect. A very important portion of this work is the testing of clinical thermometers, of which great numbers are submitted by manufacturers, dealers, hospitals, physicians and the several medical departments of the Government. Some interesting appliances have been gotten up and constructed in the instrument shop in order to facilitate the rapid execution of this work. One of these devices is a whirling machine. As is well known, clinical thermometers are and must be self-registering, since they cannot be read while exposed to the temperature which it is desired to measure, and this feature makes it necessary that they be shaken back after the reading has been taken. With the great numbers of thermometers which are here tested it would take an inordinate amount of time to shake the instruments by hand; so they are placed in this whirling machine, which will hold 48 thermometers at once, and by which the registering index is driven back by turning the crank. This machine also applies one of the tests to which the thermometers are subjected, because its speed is regulated to be equivalent to what a physician or a nurse will be able to do by hand in driving the column down, and any thermometer whose column is not driven back at this standard speed of the machine is rejected as not being fit for practical use.

Scarcely a problem can be taken up concerning the construction of standards or properties of materials that does not involve chemical preparations, chemical analysis, or the co-operation and advice of expert chemists. The entire work of the Bureau has been greatly strengthened and its efficiency increased by the organization of the work in chemistry.

THE LOW-TEMPERATURE BUILDING.

This building, shown in Figs. 14, 15 and 16, is not, with respect to its interior equipment, quite completed. Its object is to accommodate the machinery and apparatus necessary for the liquefaction of air, hydrogen and other gases, and to provide space and facilities for low-temperature experiments. The building is about 28x58 feet and two stories high, being built of dark-red brick, trimmed with limestone to correspond with the main buildings. It is connected with the sub-basement of the mechanical laboratory by means of a tunnel, through which water, gas, steam and waste pipes and wires are carried. The Bureau purchased from the British Government a complete tank for the liquefaction of air and hydrogen; this was built in London and was exhibited in 1904 at the Louisiana Purchase Exposition. The apparatus consists of a hydrogen generator and gasometer for storing the gas; power pumps for compressing air and hydrogen to 3000 pounds per square inch, and heavy cylinders for storing hydrogen at this pressure; a combined air and hydrogen liquefier; and a machine for liquefying carbon dioxide, which is used as an auxiliary refrigerant in the process of liquefying air. In liquefying hydrogen, both liquid CO_2 and liquid air are employed as auxiliary refrigerants, the compressed hydrogen being thus cooled to the temperature of liquid air and then suddenly expanded, thereby undergoing reduction of temperature sufficient to liquefy a portion of the gas. The liquefied hydrogen may be frozen in a separate apparatus, its temperature being reduced to about 16 degrees absolute. This is the only apparatus in America for liquefying hydrogen, and it is believed to be the only one outside of the Royal Institution of Great Britain for producing liquid hydrogen in considerable quantities; that is, by the liter. It will be of great service to the Bureau in research work and also in the testing of low-temperature thermometers. In the near future a second air compressor of larger capacity will be installed, and a second liquefier for air will be added.

This completes the outline of a visit to the Bureau of Standards, an outline which, if the reader should make the visit for himself, will be found capable of extensive expansion. But though there is much to be seen which has merely been hinted at in this article, the Bureau is considered to be but a beginning in a field of great breadth; to illustrate this, an instructive comparison may be made with what the Germans have done along these lines. The Reichsanstalt has cost more than one million for the grounds, building and equipment, and they have moreover an institution for the testing of weights and measures, quite distinct from the Reichsanstalt, called the Normal Aichungs Kommission, and still another for the testing of engineering instruments and materials, these three German institutions representing an equipment cost of $1,500,000, as against $600,000 for that of the United States. This fact should be remembered in making a comparison between the results accomplished.

H. J. K.

The following correspondence recently passed between a machinery supply house and a customer in the country.

Customer—Please ship me another set of reamers ¼ to 3 inches by 16ths.

Dealer—Cannot ship anything till last bill is paid.

Customer—Cancel the order. Can't wait so long.

The French nation did well for itself when it developed the automobile industry. Twenty large motor-car factories there produce 14,400 vehicles per year, and fifty smaller factories turn out 9000 per year. The annual production in France is therefore about 25,000 chassis, which does not include carriage bodies.

Plant Inventory—Importance, Value and Method of Keeping a Going Inventory.

BY F. B. JOHNSON.

The statement that a manufacturer must have his facts available for instant reference is today almost an axiom and requires no argument. There are, however, many owners of machine shops and other manufacturing plants who have still a great deal to learn and a great deal to do before they will have on hand, and under constant review, all the facts and figures that they should have for the most economical management of their plants.

Everybody, nearly, has heard of the man who ordered for his plant a certain kind of automatic machine and found, when he had it in place ready to use, but not running, that something much better had been invented since he had placed his order. He sat down with his pencil and figured for a while and then sold his new machine for little more than scrap iron and ordered in the new invention. He was a man who understood what increased speed of production means in the way of reduced fixed and other general expense charges per unit of product. He knew also that a machine that would be idle for repairs a good part of the time could not compete with one which could be used practically all the time. He was the sort of man that keeps an account of the net worth of each machine, tool and building in his plant and can tell to a nicety when to destroy, discard or dispose otherwise of any item of plant or equipment that has outlived its economic usefulness.

A number of manufacturers of my acquaintance are keeping records of which the card forms below are typical.

Form 1 is a good form for a permanent inventory of machine tools and similar equipment where the names of the articles so inventoried are short and constitute a sufficiently complete description of them, but for general use this card is defective in one or two points. A separate space should be provided for the name of the article recorded; a space also, probably at least a whole line, should be provided for description; a space should be given for the maker's number, as it may be necessary to use it in ordering duplicate parts for repairs; it should be made clear whether the order number mentioned under *cost of installation* is the number of the purchase order issued for the purchase of the item of equipment which the card represents or the number of a shop order issued to cover the labor of installation. From the form in which the card is drawn, it would appear that the cost of installation is added to the purchase price to obtain the total cost and it then appears that the item of equipment is carried into the books at this total value and depreciated from this total year by year. I think that this method of procedure can hardly be followed in all instances. It is my belief that the cost of installation should, as a general thing, be charged to some general expense account and charged off during one year unless the equipment installed is so permanent in its nature that the cost of installation may, with evident propriety, be charged off more gradually.

It does not appear from the card whether or not costs of additions and repairs are added to book value of the item at the time repairs and additions are made. Whether this should be done depends on the nature of the repairs or additions. While no general rule may be safely formulated, it is safe to say that additions, which improve the machine so that it may be operated faster or at less cost, may be added to the book value of the machine. The same, however, is not true of most repairs; the cost of repairs should, in the main, be charged currently to general expense, as the repairs occur, though it may be distributed over several months if of such an extensive nature as to warrant so doing.

It is of great value, however, to preserve on such a card a record of the costs of all repairs; by this it may be determined how great the repair cost has been for any period, and, in this connection it should be kept in mind that during any idleness of the machine, whether due to the making of repairs or not, such general expenses as rent, interest, insurance, depreciation, etc., are going on steadily, for which reason it would appear that, in making estimates of general expenses for any coming period, allowance should be made for the amount of time the machine is likely to be idle; the ideal machine is one which needs no repairs and works full time during all working hours.

In addition to giving a basis for the retention or discarding of each item of plant and equipment, a card system, such as the above card represents, gives instantly, at any time, the current value of each item of plant equipment. A plant inventory may then be made very quickly, if a sale of the plant is considered or if fire loss is to be adjusted. It is easy to

DESCRIPTION OF MACHINE	OUR NO.	MAKER	PURCHASED FROM	DATE	PRICE	COST OF INSTALLATION ORDER NO.	TOTAL VALUE
ACCESSORIES OF MACHINE	ACCESSORIES OF MACHINE	REPAIRS Date / Order No. / Cost		ADDITIONS Date / Order No. / Cost		Yearly Dep'c't'n / %	

FORM 1. FOR PERMANENT INVENTORY.

Form 360-2

Department — Plant Investment — Machinery

No. — Name — Estimated Life

Made by or Purchased from — Date — O No. — Ratio of Depreciation

Date Installed — Original Cost $ — Ins. Cost $ — Total Cost $

Betterments					Depreciation					
Date	Order No.	Item	Value	Total	Date	Amount	Bal.	Date	Amount	Bal.

FORM 2. FOR GOING INVENTORY.

COST OF MAINTENANCE

Date	Order No.	Val. of Repairs	Date	Order No.	Val. of Repairs	Date	Order No.	Val. of Repairs	Remarks

FORM 3. REVERSE OF FORM 2.

JIGS AND TOOLS

Name of Part — No. of Part

Order No.	Month	No. of Tool	Description	Operation	Cost	Date Discarded	Discard Charged to

FORM 4. SPECIAL FOR JIGS AND TOOLS.

tell what a machine or tool is worth, if it is to be sold or whether a second hand machine of the same type offered for purchase is by comparison a bargain or not; such a record increases the sale value of any plant.

The importance of being able to tell instantly the sale value of an entire plant, and of each item it consists of, was very well illustrated lately in an instance which came under my notice. A manufacturer of a certain kind of steel product was approached by a would be purchaser just at a time when he wanted to sell, and negotiations moved along very rapidly for a time, but when he named his price, the manufacturer was asked, as a matter of course, to justify it, and this he attempted to do. He stated that his price included so many dollars for ground, so many dollars for buildings, so many for good will, so many for patents, so many for machinery, tools and equipment of all kinds. He had no trouble justifying his price until he came to machinery, tools and other equipment, and here he fell down. If he had possessed such a record as is outlined above, either he could have justified the price he asked, or he would not have asked so high a price in the first instance. In the end he accepted a lower price than he would have received had he been able to tell without hesitation the value of his plant.

Form 2 is likely to find more general favor, as it avoids a number of things criticized in Form 1. Four colors of this form are used by the concern that originated it; one for buildings, one for machinery, one for jigs and tools, and one for patterns, templets, etc. The reverse of Form 2 is Form 3, which is used for accumulating the cost of repairs. Such repairs as are clearly betterments are transferred to the front of the card. Form 4 is used by a third concern to cover jigs and tools only.

From my own experience, I cannot urge too strongly the value and importance of such records as are illustrated above; the more complete and accurate they are, the greater their value. The full size of all the forms is 5x8 inches.

A New English Lathe.

BY I. WILLIAM CHUBB.

The Tangye Tool and Electric Company, Ltd., Birmingham, has recently introduced an all-gear head in connection with its high-speed lathes, although it can of course be applied to other machine tools and is suggested for use with motor cars. Figs. 1 and 2 illustrate a 32-inch lathe of the firm's latest pattern, with a head of the kind mentioned. The bed is 16 feet long, 8 feet between centers, swing over the carriage 23½ inches. The gap will take work up to 54 inches diameter by 18 inches long. The spindle is 7 inches diameter by 10 inches long in the front bearing. The back bearing has a series of collars for taking the end thrust. The drive is through a 24-inch pulley, for a 6-inch belt mounted on a shaft at the back of the headstock. It runs in gun-metal bearings, with continuous oil ring lubricators. The gearing, hereafter described, combined with a two-speed countershaft, gives 24 speeds to the lathe, ranging from 2.2 to 200 turns per minute. The tailstock has a spindle 5¼ inches diameter and is moved along the bed by a rack and pinion. The carriage travels on square slides, the feed rack is secured to the bed so that its teeth are in a vertical position, the pinion which engages it has two bearings in the carriage, one on either side of the rack to prevent it being pushed out of gear. The longitudinal and cross feeds are as usual operated from a splined shaft at the front, and have six changes by means of levers on the gear box, the screw-cutting being controlled by the lead screw. The longitudinal feeds are 4, 6½, 10, 16, 26, and 40 to the inch, and the cross feeds 6, 10, 15, 24, 39, and 60 to the inch. The lathe is also fitted with a taper attachment at the rear, shown in the back view Fig. 2. All the gearing is, of course, cut, all the pinions and many of the larger wheels being of steel.

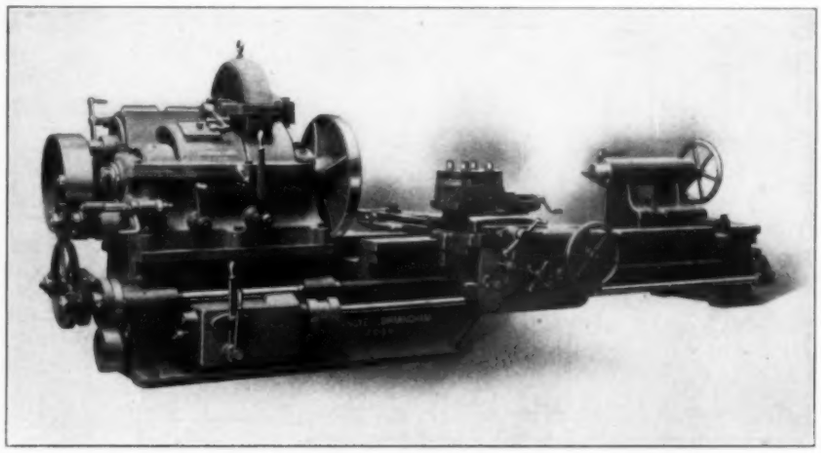


FIG. 1 FRONT VIEW OF ENGLISH ALL-GEAR HEAD LATHE.

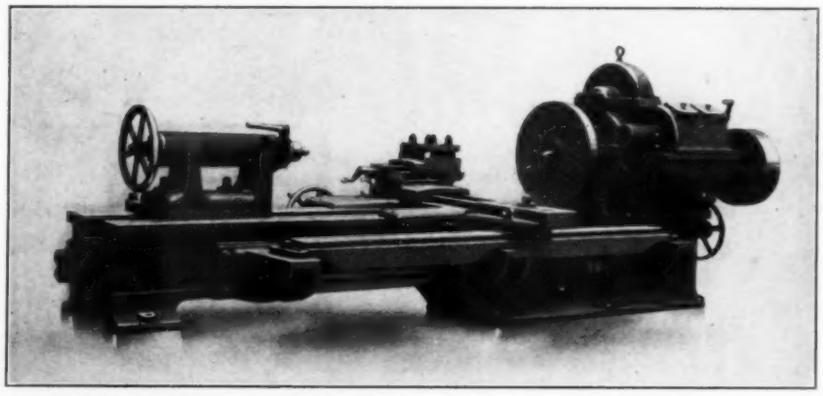


FIG. 2. REAR VIEW OF ENGLISH ALL-GEAR HEAD LATHE.

The principal feature of the machine is the all-gear headstock. Details of this device are given in Figs. 3 to 5 which, however, apply particularly to another machine; the only essential difference being the fast and loose pulleys shown. In the 32-inch lathe a single pulley is used, the lathe being stopped and started by means of the countershaft. In this head three parallel shafts are employed, two of them carrying sliding gears. A conventional section of the device is given in Fig. 3, all the shafts here being in the same plane. Fig. 5 is an end elevation indicating the positions of the gearing. The shaft on which are the fast and loose pulleys has a sleeve which carries pinions of three different sizes, the pinions being fixed relatively to one another. Interposed between the lathe spindle and this driving shaft is an intermediate shaft which itself bears three wheels and a pinion. With these wheels the three pinions on the driving shaft can, in turn, be brought into gear. The intermediate shaft is thus capable of three different speeds. The gearing for this shaft is also keyed to a sleeve which, however, has no longitudinal motion. On the lathe spindle are two wheels held together and fitted on a sliding sleeve which throws either wheel into gear with a wheel or a pinion on the intermediate shaft. In this way the number of speeds obtained on the second shaft is doubled. A further doubling is obtained by means of a pinion on the same sleeve toward the right. This sleeve can,

by means of a positive clutch, be caused to drive the spindle direct or with the clutch out of action, the pinion gears into a wheel secured to a pinion on a second intermediate shaft, this in turn transmits the motion to the large wheel keyed to the spindle itself. This second intermediate shaft is not shown in Fig. 3, but a detail of it is shown in Fig. 4. In this way 12 speeds are obtained, a two-speed countershaft increasing the number to 24.

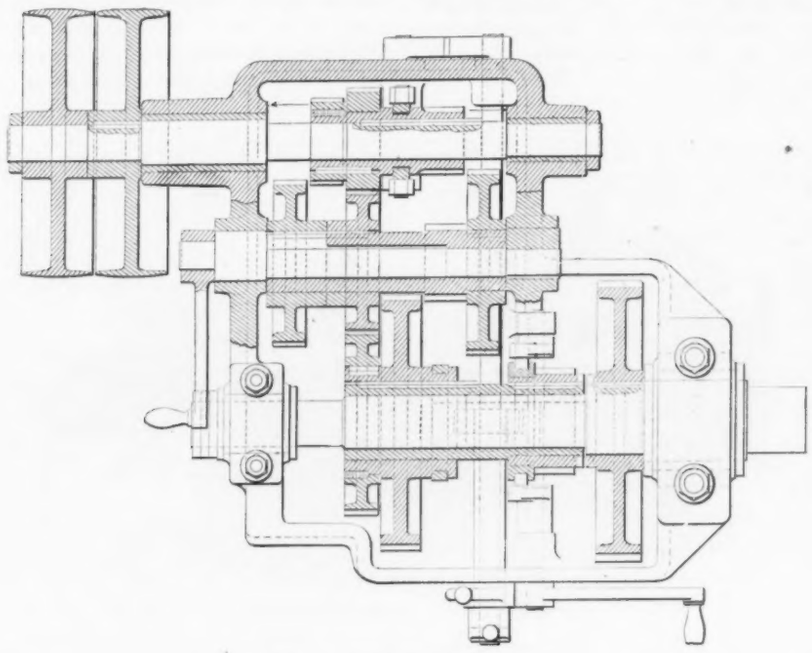


FIG. 3. SECTION OF HEAD.

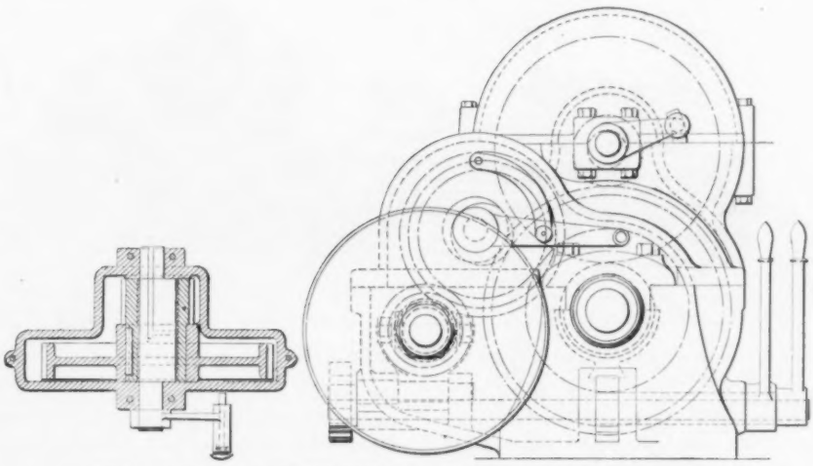
The positions of the two sleeves that slide on the spindles are controlled by means of two handles on the front of the headstock. One handle is connected to a long shaft going right across the device and carrying a toothed quadrant at the back which gears with a smaller quadrant on a short parallel spindle. This in its turn controls the position of a yoke engaging the sleeve on the first or driving shaft. Then by means of a tubular shaft placed over the long shaft just mentioned, a pinion is controlled which gears with a rack cut on a slide under a second yoke which governs the position of the second sleeve. The clutch for the final change of gearing is controlled from a handle shown in a horizontal position in Fig. 3; it is held on a spindle carrying short cranks which throw the pinion sleeve into and out of direct gear with the last wheel. For ease in moving the sleeves the intermediate shafts are supported eccentrically and their positions are controlled by suitable handles.

The 32-inch lathe here illustrated will take cuts ⅞ inch deep, 10 to the inch of feed, at a cutting speed of 50 feet per minute in mild steel.

Concrete should be thoroughly dried before applying paint to it, and the older it is, the better is the result attained.

Standard Hose Couplings.

At page 685, Vol. 28, Part 2, we published particulars of the fire-hose coupling standard adopted by the National Fire Protection Association at its last annual convention and since then approved and adopted by many other prominent associations. A special committee of the N. F. P. A. with F. M. Griswold, of New York City as chairman, has had this matter of a standard coupling in hand for a long time, and it is largely due to Mr. Griswold's efforts during the past several years that the standard mentioned has been devised and adopted by different bodies as referred to above. The committee has now issued a document giving full size drawings and complete dimensions of the 2½-, 3-, 3½- and 4½-inch sizes of hose and hydrant couplings standarized by the association and emphasizing the desirability of the early installation of standard couplings in every town having a fire department and a water service.



FIGS. 4 AND 5. SMALL INTERMEDIATE SHAFT AND END VIEW OF HEAD.

The drawings of the couplings, both male and female, are presented in *Insurance Engineering* for April, together with the general information issued by the committee, and from that journal we reprint the following particulars relative to the method and expense of installing the new standard, which it seems has already been adopted by one of the most important cities in the country, namely, St Louis:

While it is not to be assumed that all couplings and attachments for fire service which now differ from the established standard can, or will be immediately discarded for that, it is possible to make the substitution gradual, easy and inexpensive by the use of adapters at all hose and hydrant couplings until the fixed connections on the established standard gage may be made permanent on the plant already installed, while on new hydrants and hose, standard gage should be specified as an essential to acceptance. We are reliably advised that adapters cut to the established standard gage on one side, and on the other side to the present gage in use in any department, may be had at a cost of $1.00 each, and can be used for either hydrant or hose couplings.

Another point in the matter of economy of substitution is to be found in the fact that all couplings having seven, seven and a half, or eight threads to the inch, with diameters ranging from 3 1/16 inch to 3⅛ inch to the outside of the male thread, may be made serviceably operative with a standard female coupling of seven and one-half threads to the inch, by cutting down the excess diameter as the case may require, and this without seriously impairing the strength and efficiency of the coupling. Reliable data, upon which is based the nomination of the established thread, show that the standard 7½-thread female or swivel coupling will accommodate about 70 per cent. of the couplings now in use in this country under the conditions as above indicated.

Museums of Security—Preliminary Announcement of an Exposition.

At page 482 we referred briefly to the subject of museums of security which is being taken up by the American Institute of Social Service, and promised to publish a few pictures illustrating the matter; these pictures are presented in this issue, together with an announcement which should be of considerable interest.

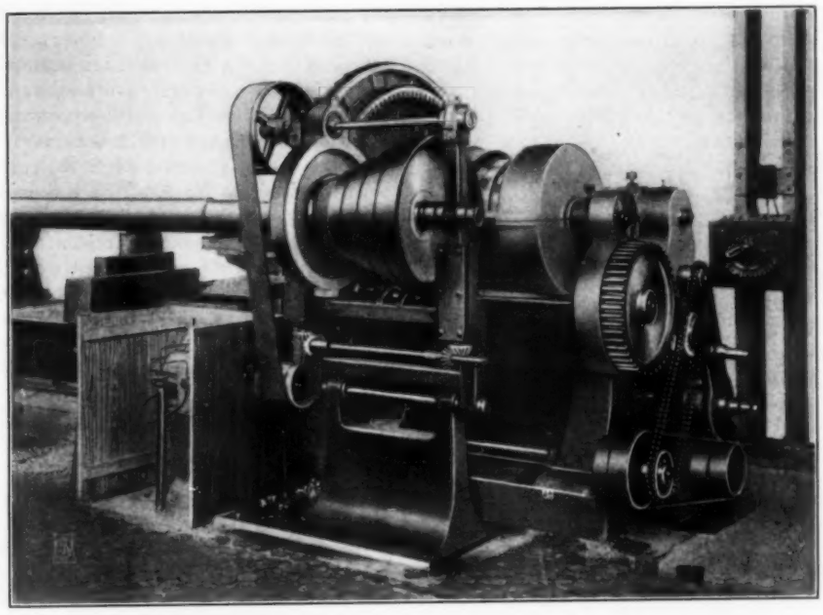


FIG. 1. GUARDS FOR LATHE GEARS.

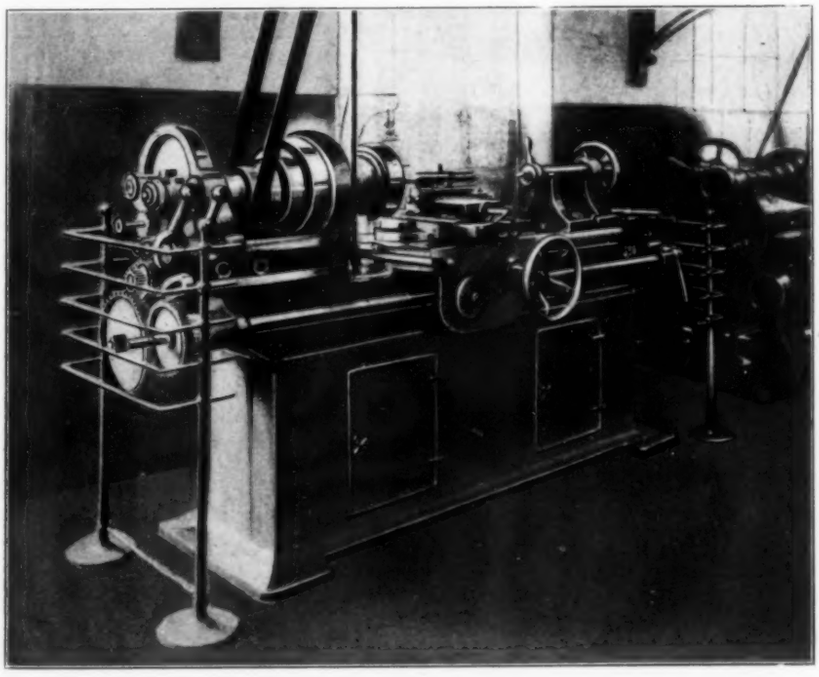


FIG. 2. GUARDS FOR LATHE GEARS.

First, in order to give an idea of what the institute is, we quote a few sentences from a paper on "The Development of a World Life" by Dr. Josiah Strong, president of the institute, which struck us as being merely the application to the different countries of the world of a principle which is now very widely recognized as applied to industrial establishments and machine shops:

"Isolation is the mother of ignorance, and ignorance is the prolific mother of misunderstandings and prejudices, racial, national, political and religious. . . . Each nation has a conceit of superiority, is disposed to magnify its own excellences, and to minimize its own defects. But we are beginning to realize that every civilized people has much to learn, and something to teach; and that nation which is the most willing to learn from the experience of others will gain wisdom at the smallest cost and make the most rapid progress. Less than half a century ago, Japan definitely adopted the policy of profiting by the experience of other nations, and as a result, she has made more progress in forty years than any other Oriental people had made in forty centuries.

"The American Institute of Social Service was organized seven years ago in New York for the express purpose of placing human experience on file, and of making it available for the benefit of all who wish to profit by the experience of others. It was intended to meet the peculiar needs of the transitional period in which we live, by helping to solve the social problems created by new industrial conditions."

It is evident that the institute's ambitious undertaking enters upon a pretty broad field, and the line of effort to which we now refer is merely one of the matters with which it is concerned. The institute has published a pamphlet containing an article entitled "The Perils of Peace," which states that "In these piping times of peace, we in the United States kill in four years some 80,000 people more than all who fell in battle and died of wounds, on both sides, during the four years of our Civil War. That is, in the same length of time we are now killing 53 per cent. more people than two great armies could destroy, equipped with all the weapons of death that ingenuity could then devise, and making destruction their eager business. We are killing more than twice as many every year as perished by violence in both the French and English armies during the Crimean War. There are more

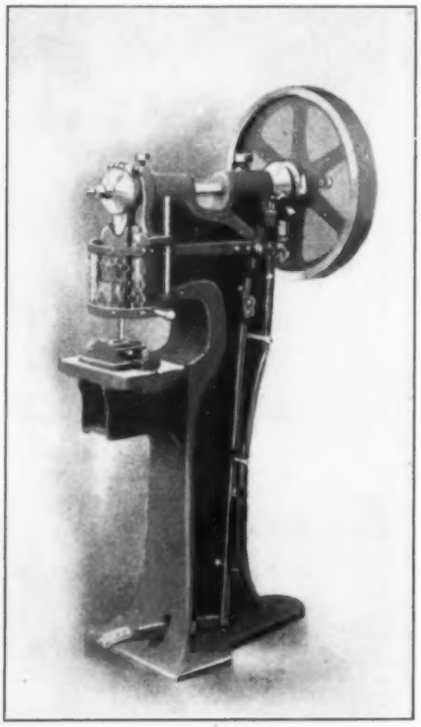


FIG. 3. GUARD FOR RECIPROCATING PARTS, ALSO OVER PULLEY ARMS.

killed and wounded on our railroads every year than the entire losses of the Boer War, on both sides, in three years."

The idea is very well put in the following words:

"We commend the common sense of those who build a fence at the top of a precipice, even more than we admire the philanthropy of those who keep an ambulance at the bottom." And it is, figuratively speaking, to build fences wherever possible, that the Institute is now working; it has reached a point where it is able to make the following announcement, which we take from the pamphlet mentioned:

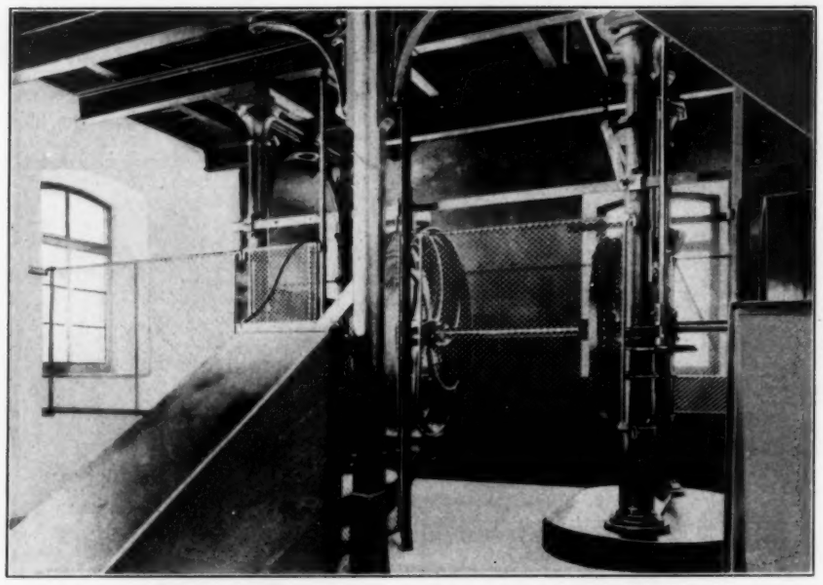


FIG. 4. GUARDS FOR BELT AND PULLEYS.

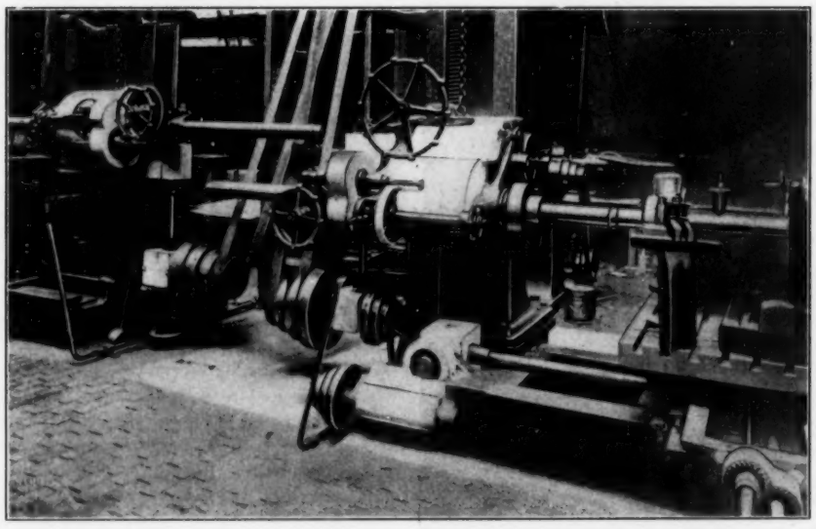


FIG. 5. GUARDS FOR GEARS.

SECURITY AND HYGIENE EXPOSITION.

"The American Institute of Social Service will hold for two weeks during the coming year an exposition of the best devices for safeguarding the lives and limbs of workmen and preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. The exhibits will consist of models of machines of actual or reduced size in operation, and photographs.

INDUSTRIAL HYGIENE.

"The Section of Industrial Hygiene will include exhibits of the various movements for improved housing and different phases of organized efforts to prevent tuberculosis. As far as may be possible this section will be comparative in exhibiting the best illustrations of English and European institutions and societies.

A MUSEUM OF SAFETY DEVICES.

"The exposition of safety devices will be temporary, but preparatory to a permanent collection of safety appliances, because the American Institute of Social Service firmly believes that the time has come for the establishment of a Museum of Security for America. With this end in view, it has been quietly collecting photographs, specialized reports, documents and publications showing the entire range of industrial betterment movements.

"What is now needed is a building where this nucleus can be expanded into a collection of models, and protected machines in actual operation, rooms for displaying photographs and other illustrated material, a hall for conferences and lectures, rooms for special local exhibitions in the various industries, a library with specialized works on industrial sanitation and hygiene, a bureau of information through the services of which reports may be made to business men and firms who are clients of the institute. Such a museum of security for America will mean the saving of thousands of lives, and through the prevention of accidents hundreds of thousands of workmen will not be disabled, thus becoming a charge on their families or dependent on the state.

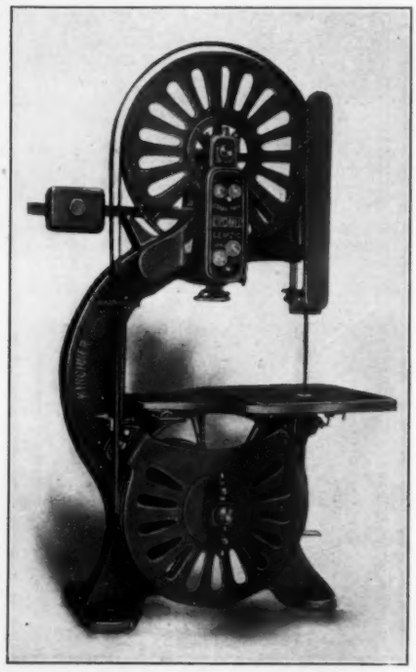


FIG. 6. GUARDS FOR BAND-SAW AND PULLEYS.

It will also lessen liability for damage suits growing out of accidents. The business men of this great country should rally to the support of such an institution. In these days of imperial and colossal fortunes, the foundation of such a museum would offer, not only a new way of spending money for America, but would be a personal memorial that would make the name of the founder beloved for all time.

"All applications for space at the Safety Exposition and requests for general information should be made to W. H. Tolman, director, 287 Fourth avenue, New York," from whom copies of the pamphlet may be obtained by those interested.

FOREIGN MUSEUMS OF SECURITY.

The foreign museums of security from which the pictures published herewith were taken are described in a paper by Dr.

Tolman and published in the monthly journal of the institute—*Social Service.*

The museum in Amsterdam owes its origin to the Association for the Development of Manual Training and Hand Work in Holland. In 1889, connected with the association, was an advisory commission, which proposed an exposition that would promote the purpose of the association. That commission reserved for itself the choice of the articles exhibited, for a nucleus of a future museum. The exposition held in Amsterdam in 1893 was an immense success, awakening the interest of the entire country, which immediately recognized its economic importance. At the close of the exposition, the Amsterdam section proposed the foundation of the museum of security, and placed there fifty of the exhibits, which served as the beginning of the institution. It was in charge of a committee of twelve, who requested contributions from the state, the city and individuals. The state gave them annually $1,250, the city of Amsterdam the building, while individuals contributed the balance; in addition a portion of the profits of the exposition was given to the museum. The museum was opened in 1893, under the direction of Van Etten, a mechanical engineer charged with the supervision of the machinery, and also its explanation. The museum is open free to the public four days in the week, and the first and third Sundays of each month.

The labor inspectors of Holland find that the museum is of the greatest service to them, because it meets every objection on the part of a superintendent that the safety device in question will interfere with the proper operation of his machinery. If the manufacturer is not satisfied with the photograph of the appliance, he can send his superintendent or go himself to the museum, where he can study every detail of it and see it in operation. One room contains the library, filled with books on hygiene, sanitation, industry and social economy. A gas engine is provided so that the machinery can be exhibited in operation. The various parts of all dangerous machines are safeguarded by means of the latest devices, the safeguarded parts being painted red. Hygienic devices are painted blue. There can also be found here systems of ventilation, safety scaffolds for builders, and a series of lay figures wearing various safety devices; some of them resembling football players in the protected devices with which they are armored.

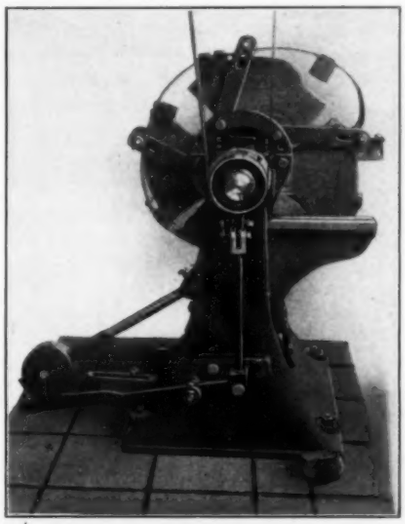


FIG. 7. BROKEN GRINDING WHEEL RETAINED BY THE GUARD.

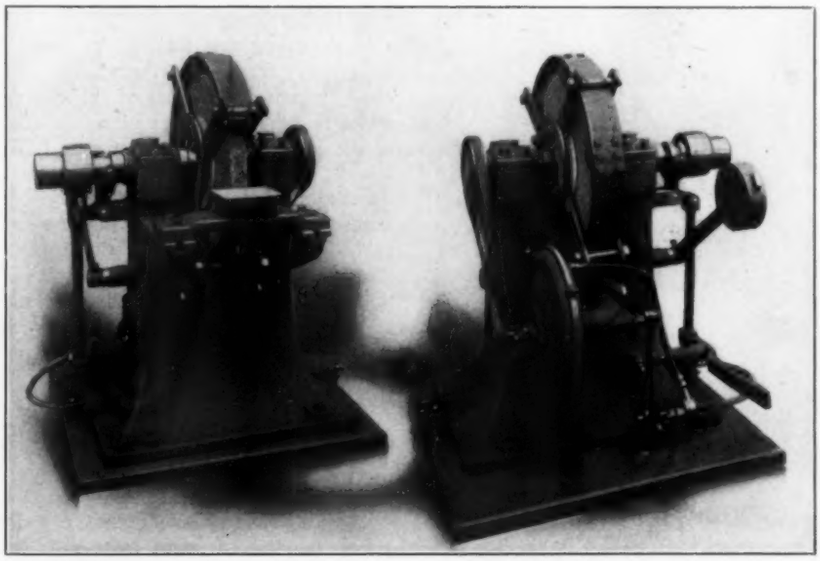


FIG. 8. FRONT AND BACK VIEWS OF GRINDER WITH GUARD.

The museum at Munich was opened to the public on Oct. 21, 1900. The funds necessary for the establishment were provided under arrangements made by the Minister of the Interior, and a munificent gift from the Munich Polytechnic Association of money accumulated for some years for the purpose of creating a hygienic museum. Through the generosity of constructors and industrialists a great many models of machinery were offered to the museum.

The museum occupies five rooms which were put at its disposition gratuitously by a large paper manufacturing company. It contains a library, publishes pamphlets and articles and holds conferences on questions of interest regarding the moral and material welfare of workmen.

In 1889 an important exposition of devices for the prevention of accidents to laborers was held in Berlin. The desire to preserve these valuable documents and other exhibits led to the thought of creating a special museum where they could be shown. But it was not until 1900 that the Reichstag made an appropriation of $142,000 for the creation of a museum, $119,500 to be used in purchasing ground and $22,500 for building, and in the two following years $75,000 and $43,750 were appropriated. Subsequent appropriations for maintenance were also made.

The museum building is divided into three parts:

1. The administrative, comprising offices in the basement; rooms for one of the officials, a library, lecture hall and special museum for tuberculosis.

2. A grand hall; a basement comprising an area of 1610 square yards, where the machinery is set up; a large gallery of 810 square yards reserved for models, plans and photographs.

3. The administration building and the grand hall are united by a vestibule in the basement. Above this vestibule is an assembly hall with 196 sittings. The building encircles a court.

The museum is really divided into two great sections, one comprising all that has to do with prevention of accidents in the various branches of industry, and the other comprising social and industrial hygiene. It has not presented any kind of apparatus that has not proved practicable; it attempts to show the protecting devices in their ordinary size and on machines that may be set in motion. There are 85 machines operated by power and 30 that may be operated by hand. The other exhibits are models, designs and photographs. The machines form five independent groups and each group can be operated alone. Four large electric motors furnish the power for the five groups and 11 electric motors are used to drive individual machines. In the vestibule are shown varieties of protectors for the eyes, to guard against flinty substances, flame or matter at white heat; and there is a collection of model clothing for men and women. The ground floor of the grand hall is reserved for machines in movement.

We will not take space here to enumerate all the varieties of safety devices for such pieces of apparatus as elevators, woodworking, metal-working, printing, soap-making, tiling and brick paving,

textile, agricultural, and mining machinery, boats, steam devices, chemical apparatus, scaffolding, etc., not to speak of the numerous features in the departments of hygiene and sanitation. The thoroughness here can be indicated by one example, viz., in the matter of pure air, various appliances for ascertaining the degree of vitiation are shown, and microscopic views of the dusts generated in various industries, with colored photographs indicating the action of the dust particles on the lungs of the workmen; whether this yet includes subway track walkers, in whose lungs metallic dust from the train brakes has been found, we have not learned.

In France there are three large associations for the prevention of accidents in factories and workshops, which vie with each other in their efforts to secure the very best improvements both at home and abroad in devices for the prevention of accidents to workmen and to introduce them into the factories and workshops of France. The Manufacturers' Association of France holds each year an international meeting for the purpose of arousing interest in inventions for the protection of workmen from dangerous machinery, the encouragement of new attempts and suggestions for the improvement of devices already in use. Owing to these efforts there is an active propaganda with an excellent system of factory inspection, so that industrial establishments quite generally have fallen in line and for the most part their machines are equipped with safety devices. There is now a movement in France to go one step further, viz., to establish in Paris a museum of security.

We do not think that the readers of the AMERICAN MACHINIST will need any further explanation of the pictures beyond the titles affixed to them; we might simply remark that the last one does not represent the chauffeur of an automobile, but shows one of the least grotesque-looking of a class of appliances which the workmen in Germany appear to be willing to wear, and which class includes devices for the protection of the eyes, shields and respirators for use in the neighborhood of fire or incandescent materials, or dust, smoke, flying particles, noxious vapors, etc.

FIG. 10. GOGGLES TO PROTECT THE EYES FROM DUST, EMERY, POWDERED STONE, ETC.

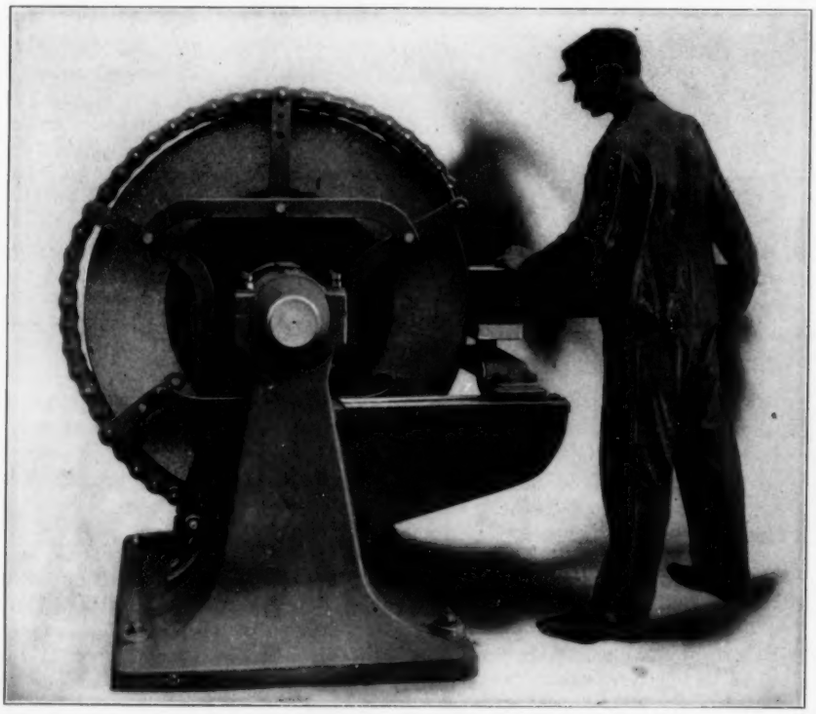


FIG. 9. CHAIN GUARD ON A GRINDSTONE.

Though the provision of safety devices is, in this country, looked after to some extent in the construction and installation of machinery, there is no doubt but that there is considerable room for improvement in this respect, and it is to be hoped that the movement will attract the attention of those upon whom the responsibility rests.

Starting of an Allis-Chalmers Turbo-Generator in Brooklyn.

One of the Allis-Chalmers type of turbo-generator, of which we illustrated some features at page 178, was recently started up in the Kent avenue power house of the Brooklyn Rapid Transit Company under rather unfavorable circumstances, with, however, very satisfactory results. This machine is of a rated capacity of 5500 kilowatts, and was lying idle during February and the greater part of March, in an uncompleted power house, while awaiting the completion of the boilers, condensing apparatus, piping, etc., and as a consequence the insulation of the generator windings became damp. In order to dry out the generator, the unit was started up at part speed, as soon as steam was available, but on March 27, an accident at another power house leaving the railway company short of power, the turbine was run at the full speed of 750 revolutions per minute for the first time since its installation. In less than half an hour they started to put some load on it, and in a little over an hour after starting the turbine was carrying 3000 kilowatts, and the next day the load ran up to over 5000 kilowatts; the day after it reached 7000 kilowatts; the generator running until late each night.

In designing this turbine the metal in the cylinder was so distributed as to overcome the upward arching of the cylinder, which is sometimes met with as the result of the use of superheated steam. It was found, however, that this compensation was slightly overdone, so that the cylinder sagged down with the result that the rotor rubbed for nearly a third of the length of the turbine, but no damage was done to the blades, on account of the protection afforded to them by the shroud ring described in the article on the Utica turbine already referred to. The turbine has since been running very satisfactorily, and at times carrying heavy overload; the highest temperature rise so far met with, has been 25.5 deg. C., 78 deg. F.

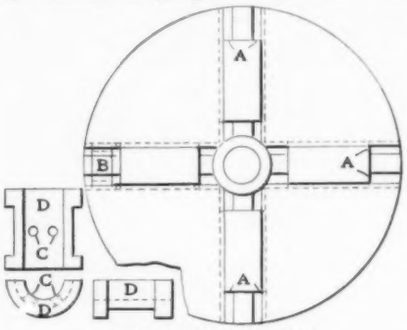
The *Litchfield* (Connecticut) *Enquirer* states that the employees of the Bantam Anti-Friction Company, of that place, collected and packed a large box full of clothing, shoes, etc., for the San Francsico sufferers, these things to be distributed under the ausupices of the Red Cross Society.

A 24 h.p. DeDion automobile made the trip from London to Edinburgh in less than 20 hours, without stopping the engine.

Letters to the Editor.

Repairing Worn Chucks.

The ordinary style of jaw chuck almost always develops an excessive amount of wear at the shoulders *A* as the thrust of the screw is on a half circle bearing and the chuck body is generally soft iron. Chucks worn in this way can be repaired by making a gang milling cutter the

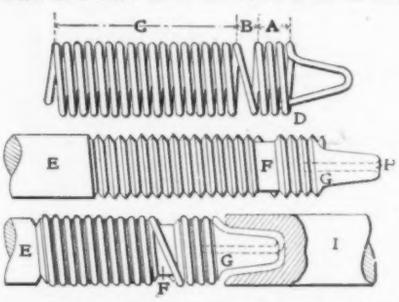


REPAIRING WORN CHUCKS.

shape of the half bushing shown at *D*, then milling the chuck as shown by the dotted lines at *B*. The bushings are made of tool steel hardened. They can be easily made by chucking two pieces together, thus finishing two halves at once. Before hardening they should be fitted in place, and the holes at *C* drilled for dowel pins to keep them from turning. A chuck fitted up in this way is as good as new, possibly better. W. T. H.

Making a Small Spring.

The spring shown in the illustration is made of brass wire 0.019 inch thick, the outside diameter of the spring is 0.157, and its length over all about 1⅜ inches. This spring forms part of a drawing office requisite made by Theo. Alteneder & Sons, Philadelphia. To make one spring approximately this shape is, of course, no very great job, but to make a thousand of them and have them all come alike is not



THE SPRING AND THE RIG FOR MAKING IT.

so easy. The most difficult part is probably the bringing of the end *D* inside the coils. A little rig was made for the lathe; with it an inexperienced boy can turn them out with great rapidity, each spring practically an exact duplicate of every other spring.

The mandrel *E* is threaded the required pitch. The threads at *F* are cut away; the end *G* is turned to the desired shape, and a hole *H* drilled to correct depth to serve as a stop for the wire. The mandrel *E* is held in a chuck in the headstock of a speed lathe. A piece like *I*, shown partly in section, is fitted to the tail spindle.

The end of the wire is then inserted in the hole *H* till it touches the bottom; the piece *I* is then brought forward, bending the wire over the end *G*; the lathe is then turned by hand, the wire following the thread till the break at *F* is reached; it is then led across the gap till it engages with the thread again, the lathe being turned by hand till the spring is finished. As soon as the tension on the wire is released the spring naturally opens slightly, and is easily removed by turning the lathe backward. DIXIE.

Another Thing that is Usually Wrong—Dovetails.

In reply to Professor Sweet's article on dovetails, at page 512, my table of angles at page 361 to which he refers, was

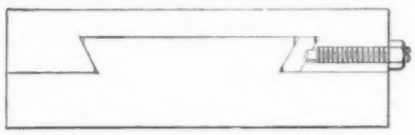


FIG. 1

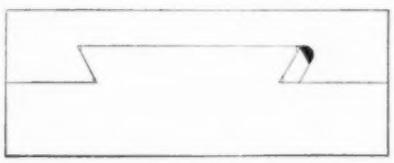


FIG. 2
DOVETAILS.

not intended to show any design, but was arranged for solving a common arithmetical problem in designing.

As a matter of fact we make our dovetails one-sixteenth to one-eighth flat on the edges, as shown in Fig. 1, and the tables referred to are carried out to small dimensions in order to provide for this. We plane these flats perpendicularly for convenience in machining.

We also make our gib screws with a cone point as indicated in Fig. 1, which seems to have all the theoretical advantages of the round point, and makes a much easier machining operation.

With regard to the dovetail with a large radius, which is re-illustrated in Fig. 2, would there not be a large opening which would be unsightly where the slide is shorter than the rest? Moreover it would require difficult tools to keep up and would not be an easy form for scraping.

In regard to tapered dovetails being used on all modern machines, as it rather strikes home, I have taken a walk through the shop to see how far behind the procession we are. Out of about thirty-five milling machines of various types, sizes, and makes, fully one-third of them having been bought within the last two or three years, I find only one make which uses tapered gibs, probably because the rest of us are willing to approach less closely to theory and be satisfied with an easier machining operation which furnishes a wholly satisfactory construction. H. F. N.

Interchangeable Boring-Bar Cutters.

The question as to the best and most convenient boring-bar cutter and method of holding it, which was presented by A. V. at page 419, will probably interest a great many others as it does me. Mechanics have used different kinds with more or less success; no doubt in plenty of cases, wondering meanwhile if the tool was not the product of some leaky brain. I have made or used almost every kind of inserted or attached cutter for boring bars that I have seen or heard of in the last twenty years. The method of holding the cutter shown in Fig. 1, being one of the first good designs I remember, is very convenient where it can be used, well adapted for bars for chucking work and counterbores; cutter *A* being centered by the pin *C* and clamped by the collar *B*, which is screwed on the bar *D*, right or left hand, as the case may require, and preferably with a fine thread.

The form of cutter shown at Fig. 2 has, in my experience, proved to be the best design for vertical and horizontal boring machines where the bar passes all the way through the work, and all portions of the bar must be the same diameter. *D* represents the bar with the ordinary slot of suitable size to receive the cutter *A*, which is both held central and secured firmly by the screw *B*.

About 30 deg. included angle being the most suitable taper for the screw, it will be found that the cutter is easily secured by a slight pressure of it. The cutters should be marked the way they go in the

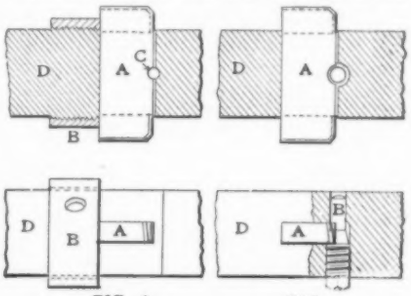


FIG. 1 FIG. 2
INTERCHANGEABLE BORING-BAR CUTTERS.

bar in order to avoid getting them in wrong; still, this can be overcome by having the half-hole taper to the center of the cutter from each side.

Making and fitting cutters of this kind accurately is merely a good mechanical job. Should there be a sufficient number of cutters or bars to be made or accuracy demand it, it will be best to make a jig for the purpose of drilling and tapping the locking screw-hole, as well as a master bar for grinding the cutters. Frequently

horizontal boring machines use bars 8 feet long or longer. These cannot be handled very easily in a grinder. The simplicity of this form of cutter and method of holding, the ease with which it can be put in or removed from the bar are great advantages over any cutter requiring a wedge. The screw can be made with square or flat head and screw-driver slot.

What we are much in need of is a more simple and better way of holding a flat cutter in a bar than by the use of the time-honored wedge, which invariably springs the bar out of true. May mechanics put their heads together, devise something better, and continue to harp on the poor qualities of the wedge until it is driven out of use for this purpose.

U. B. S.

Wooden Laps.

In small manufacturing work there are often some parts that require grinding or polishing, which must be done with formed laps. Finding great difficulty in getting a wooden lap that would withstand the oil and atmospheric conditions, which either crack the wood or open up the joints, I made a series of experiments which I think will interest those who have work that requires a wooden lap. The lap is used for different kinds of work, but the one shown at Fig. 2, I think is a representative job. It is the grinding and polishing of leaves of a small pinion;

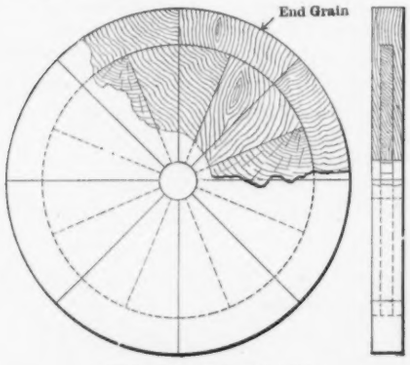


FIG. 1. A WOODEN LAP.

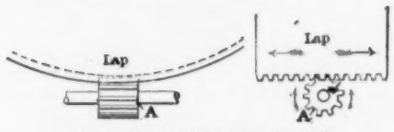


FIG. 2 HOW THE LAP IS USED.

these have to be very smooth and bright also of a proper shape. The face of the lap being the surface used must be end grain, and have no joints running parallel to the wheel, as would be the case if it were made up of two or more layers. The lap is moved back and forth across the pinion, while rotating at a high rate of speed, the movement causing the pinion to turn also, which gives it a fine polished surface, besides keeping the proper shape of the teeth. As the lap wears, it is fed into the work as required. Flour emery and oil is used on the lap, a small quantity being sufficient. The diameter of the lap is made according to the work, a spiral or worm not needing as great a diameter as a spur gear or pinion. The many laps previously made either cracked or opened up at the joints, but the one shown at Fig. 1 does neither, and gives complete satisfaction. The first one made (July, 1905) is still in use. The outside sectors are end grain, but those inside, which are for the glueing, can be of any grain, but we found that it is better to make both of the same kind of wood, namely cherry, glued together with ordinary "noodle" glue. ARTEBE.

Straightening Gun Barrels.

At page 674, Vol. 28, Part 2, appears an article by J. M. Menegus, entitled "Straightening Gun Barrels," and regarding which I wish to make a few comments.

To commence with, Mr. Menegus says: "While it is possible in guns of large caliber to bore a hole straight enough, using large boring-heads guided by brass pins, the boring of small guns—for instance, those of 2-inch caliber—is a harder task." So far as I know, boring-heads guided by brass pins are not used in the United States for boring the tubes of large caliber guns. The general practice is to use for the roughing cut a hog-nose boring-head shown in Fig. 1, of a cast-iron body with an inserted steel cutter ground to cut on its front end at right angles to the axis of the tube. The finishing cut for all calibers of cannon is made by the use of a reamer head, Fig. 2, having inserted steel cutters and supported during operations by oil-soaked hardwood blocks that are bolted to the reamer body and turned true with, but a few thousandths of an inch larger than the cutting edges of the reamer cutters. To the best of my knowledge the same methods of boring are followed for all calibers of cannon from the largest down to the one-pounder—about 1.45-inch caliber—and differ only in the design of the hog-nose boring-head for the roughing bore. For calibers below 4 inches this tool is like the reamer with the exception that the cutters are ground to cut on the front end.

I have watched the boring operations on, and inspected the bore of, several hundred gun tubes of various calibers, but have not as yet discovered that any greater difficulties exist in the boring of small-caliber tubes than are found in similar operations on tubes of large caliber; in fact the case is usually reversed.

Mr. Menegus states that "Gun barrels of such small diameter have to be straightened after being bored." This statement concerning a cannon tube seems peculiar because, if a gun tube were subjected to a straightening, or other form of stress, while cold, that produced a set in the metal, it would not be accepted by any of our Government ordnance inspectors since the principle which is the foundation of the modern theory of gun construction, viz.: *No fiber of any cylinder in the gun must be strained beyond the elastic limit of the metal of that cylinder,* will have been violated, and the tube would be more or less unsafe for service.

A slight straightening of rough gun-tube forgings is sometimes permitted by Gov-

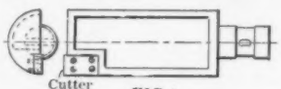


FIG. 1

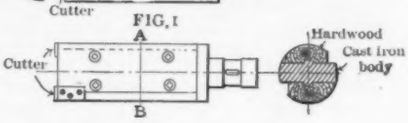


FIG. 2

BORING AND REAMING TOOLS FOR GUN TUBES.

ernment inspectors, but it must be done at a low red heat not exceeding the last annealing temperature to which the forging was submitted preparatory to the physical test of the metal of the tube.

The indicating of the bore of the tube forging is necessarily an operation *preceding* the boring in order to determine whether or not the tube has warped during the oil tempering and annealing to such an extent as to prevent its cleaning up when bored and turned to the proper dimensions. The test for straightness of the finish-bore is made by means of a cylindrical plug gage of about 5 calibers in length and 0.0005 inch below the prescribed diameter of the bore of the tube.

Is it possible that the methods described by Mr. Menegus are being followed by any American gun builder to obtain a straight finish bore when it is a well known fact that the boring and reaming tools shown in Figs. 1 and 2 will, when properly made and used, produce results that are entirely satisfactory?

W. CANTELO.

Graduating Dials with Progressively Varying Divisions.

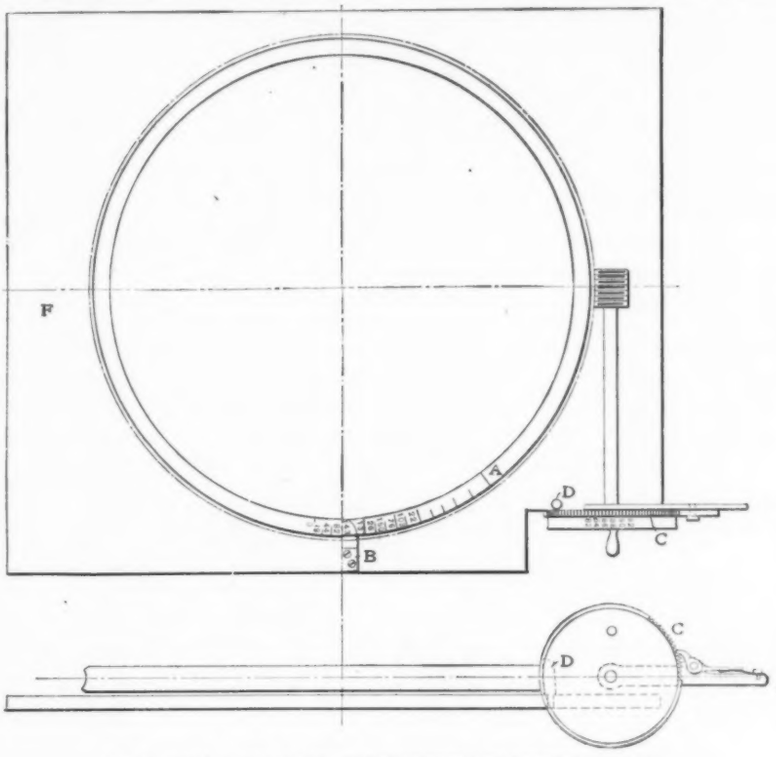
I found the article about the shop methods of the American & British Manufacturing Company at page 431 very instructive and interesting. Especially their back-facing-off tool and slotting attachment brought my admiration, as well as the milling attachment for cutting teeth on the inner surface of an arc.

I tried essentially the same thing years ago, but it did not work satisfactorily, as, when finished, the arc had straightened and the error in the spacing of the teeth with the movable finger amounted to several thousandths of an inch. When doing similar work afterward, I put the work on the circular milling attachment and spaced the teeth by a notched wheel, which I put on the worm shaft, feeding the work vertically; and then, finishing the outer and inner surface of the arc in the lathe after the teeth had been cut, it made a pretty

good job and a true circle. I am rather skeptical about the milling of a dovetailed slot on the outer surface of an arc. I believe the radius of the arc must be a very good job.

An objection to the graduating machine shown is the necessity for moving so much metal when ruling the lines and the mistakes which it would seem are likely to be made because of so much dependence being placed on the workman.

I once had a similar job to do, graduating a circle in progressively varying divisions. I thought a young man of about 18 years of age would make a better adder and subtracter than an old shop hand, but after two or three pieces had been spoiled I knew better.



GRADUATING DIALS WITH PROGRESSIVELY VARYING DIVISIONS.

To avoid further trouble I went at it the following way: I put a notched wheel *C* on the dividing worm with 180 notches, every second notch being numbered. The smallest division I could get was 10 seconds and I figured the following way:

No. of Division.	True Space.	Space Used.	Error
1	33′ 7″	33′ 10″	3′
2	34′ 8″	34′ 10″	5′
3	36′ 25″	36′ 20″	0′
4	40′ 12″	40′ 10″	2′

It will be seen that the greatest error would never exceed 5 seconds, which was correct enough for all practical purposes.

The following table was then prepared:

Division.	Distance from zero.	Dist. between each division.	Numbers of turns and teeth.	Number on notched wheel on worm shaft.
1	33′ 10″	33′ 10″	1 turn 19 teeth	19
2	1° 7′ 20″	34′ 10″	1 " 25 "	44
3	1° 43′ 40″	36′ 20″	1 " 38 "	82
4	2° 23′ 50″	40′ 10″	1 " 61 "	143
5	3° 10′ 10″	46′ 20″	1 " 50 "	13

These figures are only for illustration; the table may be continued till it takes in the whole circle or the whole spiral. The numbers on the wheel are easily found by adding the extra number of teeth to be taken on each division.

After that I pasted a paper ring *A* on the worm wheel and fastened a piece of sheet metal *B* to the table, so bent that it overlapped the paper ring, one edge of it making a radial line. The diameter of the paper ring was about one-third larger than the diameter of the ring I was going to graduate. Next I set the ratchet in notch *O* and, turning the wheel *C* around until the handle came against the stop pin *D*, made a lead-pencil line along the radial edge of the sheet-metal strip *B* on the paper ring *A* and marked it zero. Then the first division was made by turning the wheel 1 turn and 19 teeth, a lead-pencil line was made on the paper ring and marked 19, the number on the notched wheel. The second division was made with one whole turn and with the ratchet in No. 44 on the wheel, another lead-pencil mark along the edge of the metal strip *B* being made and marked 44. Continuing thus, I had the whole graduation and the numbers to which the notched wheel should be set on the paper ring.

Then I put the boy again on the machine, with instructions not to add or subtract any more, but only to watch for the numbers on the paper ring, and when they appear below the radial edge of the metal strip *B* to look for the same number on the notched wheel, put the ratchet in the notch with the same number and turn the wheel around until the handle strikes the stop pin *D*, and then pull the lever moving the slide with the cutting tool. The result was satisfactory, so that of several hundred rings we graduated we had not one spoiled one.

I would, however, suggest an overhanging stand to be put on the table at *F*, with a small tool-slide connected to a hand-lever for moving the tool, as an advantage over the arrangement shown in your paper. This would leave an expensive machine free for work that it had been constructed for. V. RELDIEF.

Shall We Patent Our Inventions?

It has been with interest that I have read in the AMERICAN MACHINIST, articles relative to patents and inventors. Especially good was the article "Shall We Patent Our Inventions?" at page 96.

The young man who has, or thinks he has, made an invention has need of much sense and sound advice before he puts any appreciable amount of either time or money into his invention. Otherwise, as soon as he sees he has something which he thinks is to revolutionize the particular class to which it belongs he rushes off to a patent attorney with a rough model of the device, is assured that no doubt a valuable patent can be secured for the invention, and then begins a series of expenses and disappointments which end in a poorer but wiser young man.

The inventor should not let his invention run away with his common sense. He should look for criticism rather than praise. He should weigh carefully its bad points as well as its good ones. Great blame is laid, and rightly, at the doors of unscrupulous patent attorneys, but the stubborn, bound-to-go-ahead inventor has made it possible for such attorneys to do a thriving business. The attorney who is honest enough to suggest that the invention is patentable, but that the patentable part is so small and easy to get around, that it will be throwing money away to take out a patent, is likely to be looked upon with either suspicion or scorn, and see the patent taken out by some less honest competitor.

The young man who has invented or intends to invent should carefully consider several things. He should confine himself to the class of work with which he is familiar. When he has made one invention he is liable to think that he can take a casual glance at most any line of work and improve upon it, but many have tried it to their sorrow. He should carefully consider whether the device is worth patenting, and not whether the device can be patented. There are several ways of arriving at a fairly accurate answer to this all-important question. In the first place, is the new device an improvement on that which is already on the market? Is it simpler? Is it cheaper? Is it so much better that a buyer would be willing to pay a little extra in the way of a royalty over the

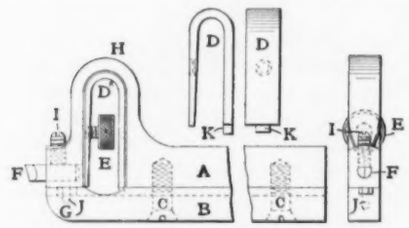
old device? Let the inventor put these questions to himself, weigh them carefully, and answer truthfully. But even if he can say yes to these questions or to most of them, let him not be satisfied with that. It is essential that he should next find out what others have done along the same line. This is not so difficult as it may seem. For the sum of ten cents he can obtain from the Patent Office a copy of the Classifications of Inventions, giving all the classes and subclasses into which the United States patents are divided. Having ascertained the sub-class in which the device would be classed, let him write and find out the cost for one copy of each patent contained therein. If the cost is not too great he should get them by all means. He may find the same thing or a dozen better, and be saved the expense and disappointment of going ahead blindly and obtaining a patent at considerable cost which will be as easy to go around as falling off a log.

The best way of all, is for him to first buy the patents and study them carefully. Then let him improve on what he finds there. If he cannot improve on what he finds there, he will do well not to go ahead with a vague idea that in some unaccountable way, to be revealed in the hereafter, the sound-headed business man is going to pick out and adopt the invention disclosed in his patent even though it isn't quite so good as some old patent which can be used without any payment of royalty.

Manufacturers are continually studying these prior patents, and are finding more and more that large sums in royalties can be saved by the use of devices covered by patents which have expired. IRV.

A Spring Threading Tool.

The drawings show a special spring threading tool that gives satisfaction and produces nice smooth threads. The body of the tool is in two pieces *A* and *B*, both made of tool steel. The bottom *B* is of ¼-inch square stock and has a ¼x⅛-inch slot in it as shown. The top *A* is made of ½x¾-inch stock and has a ¼x⅛-inch tongue, a nice fit in the slot in *B*. *A* and *B* are held together by the screws *C*. The front end of the body at *G* is hardened. The tongue and slot are ground and lapped and should be a nice sliding fit. The neck of the tool *H* is about 3/16 inch thick, the space for the spring is ¾x1⅝ inches. The spring is made of spring steel, tempered. On the bottom of the spring there is a tongue *K* to fit into the slot in the body *B*. The adjusting screw *E* is ¼-inch, 20 threads, it is to adjust the tension of the spring. The thread tool *F* is made of ¼-inch Stubs steel flatted on the top. It is held by the set screw *I*, the hole in the body not being drilled quite through so as to back the tool up. The small pin *J* is ⅛-inch diameter driven into the lower half of the body *B;* in the upper half *A* there is an elongated slot ⅛x3/16 inch for it to work in.



A SPRING THREADING TOOL.

This tool is not designed for heavy work; the largest I have ever used it on was a 1-inch 8-thread tap.

By adjusting the screw *E* you can get any tension on the spring you want to suit the size of thread being cut. As the nose of the tool is supported the tool cannot spring downward or to the side; when it strikes a hard spot it springs back.

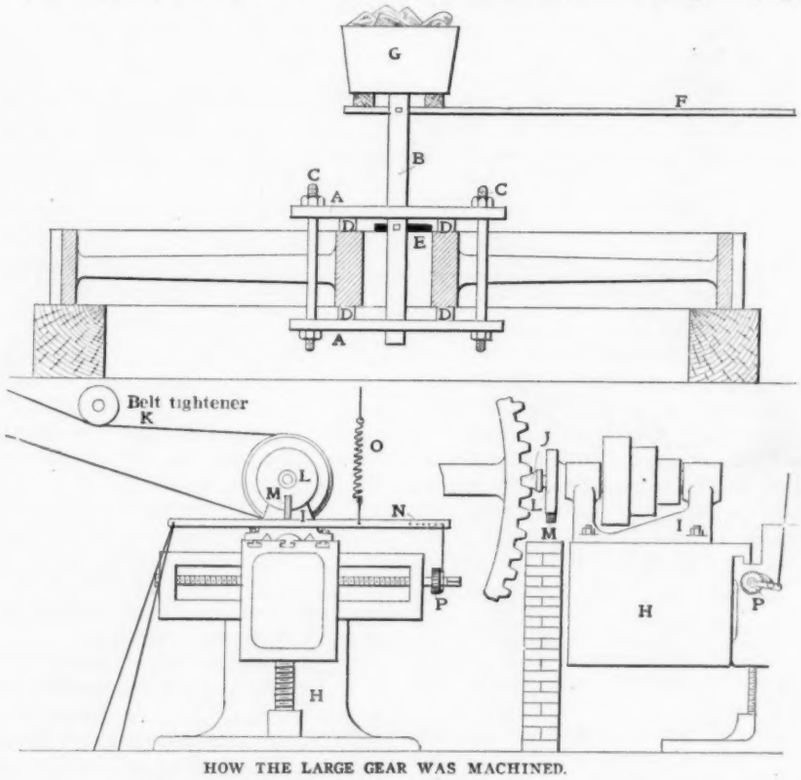
A. B. FRENCH.

Machining a Large Gear with Makeshift Tools.

Once when I was working in a small shop I was surprised to see a large gear being brought by four horses from a foundry some distance away. It was backed into a shed nearby and left there on blocks about a foot high. The foreman went out and took some measurements, and then coming over to me said, "Billie, we have got to machine that thing some way or other." "Well," I said, "I guess I can chip and file those teeth in a month or so, but boring it is another thing." "Yes," he said, " it is another and also simpler one." He told me to get two pieces of 1½-inch iron *A* two feet long by about six or eight inches wide, and bore a good smooth 3-inch hole in the center of each, and turn up a three-foot bar *B* a nice sliding fit. By this time a light began to break in, and I told him I could finish the job if he would tell me the size of the finished bore; it was to be 8 15/16 inches.

After I had the bar turned, I drilled two 1½-inch holes near the ends of the strips and getting four 1-inch parallel pieces *D* and two 1¼-inch bolts *C*, I proceeded to the shed, where I set up the strips with the 3-inch hole central. To do this I had to improvise a large pair of wooden hermaphrodites, which enabled me to get the bar central with the teeth. I now marked the bar for the tool when the bottom end was about flush with the lower strip. I drilled a hole for a ⅝-inch round steel tool *E* and set screw, and also a 1-inch hole at the top for handle *F* to provide the drive. Between 50 and 75 pounds of scrap iron *G* provided the feed according to the size of cut desired, while two apprentice boys taking turns at walking around, shoving the 1-inch bar *F* extending over the edge of the gear, supplied the rather erratic drive.

While the last cut was being taken, I personally superintended the power, making it constant by having the boys change without stopping. As one side had to be faced I drilled the bar near the lower end for a pin which rested on the lower strip. A facing tool about ½ inch wide was set so the pin was about 3/32 inch above the strip, the power was then told to turn itself on, and as soon as the pin was down



HOW THE LARGE GEAR WAS MACHINED.

to the strip, the tool was moved for the next ½ inch. As these successive "feeds" did not make the loveliest possible surface, I took an old file, ground like a scraper on the edge, and wedged it in the tool hole until it was square. A couple of turns fixed things O.K.

The next question was how to machine the teeth. A mandrel was turned so that about 1½ inches would project either side of the hub, and the whole outfit set up on wooden horses (after a hole had been dug in the ground) outside one of the windows, with the teeth just clearing the sill and arch. Inside I blocked a shaper *H* up so that when the headstock *I* of an 18-inch lathe was bolted on the table the center came level with the gear center. A cutter *J* the shape for milling the teeth, was made and placed direct in the headstock spindle. A belt *K* drove it, and for a while hand feed was employed, but the boy entrusted with this feature rigged up a ratchet feed by putting on the small driving face plate *L*, and inserting a block of hard wood *M* in the "dog slot," so that about 1 inch projected. This acted as a cam, causing a lever *N* (fulcrumed on a wire from the floor and a spring *O* from the ceiling) to work a piece of belt lacing, which in turn operated the ratchet *P*. As the cam (?) was fed over the feed became greater or less, but this was remedied by the hook at the end of the lacing being placed in different holes in the ratchet lever as required. In this way the job was completed, although I have an idea that no speed records were broken.

Canada. W. L. McL.

Welding Long Rods with the Aid of an Air Blast.

The article, "Some Recent Important Works of Scientists," at page 556, reminds me of a difficult job of welding, and how it was accomplished.

Some years ago a large foundry and machine jobbing shop received an order for some 2-inch round rods to be of an unusual length; if I remember correctly they were 50 feet in length after welding, being so long that the smith had some trouble handling them from the fire to the anvil in time to weld before they became cold.

The foundry boss came into the forge and saw Mike doing his best to stick those rods together; after he saw what the trouble was he told him to get a hand bellows and blow the ends of the rods after taking them out of the fire, saying he could weld them in this way without further trouble.

Mike and the superintendent both laughed and gave the foundry boss a wink—as much as to say, "we are both on to your joke." They thought, very naturally, that a blast from a hand bellows would cool the rods so much sooner.

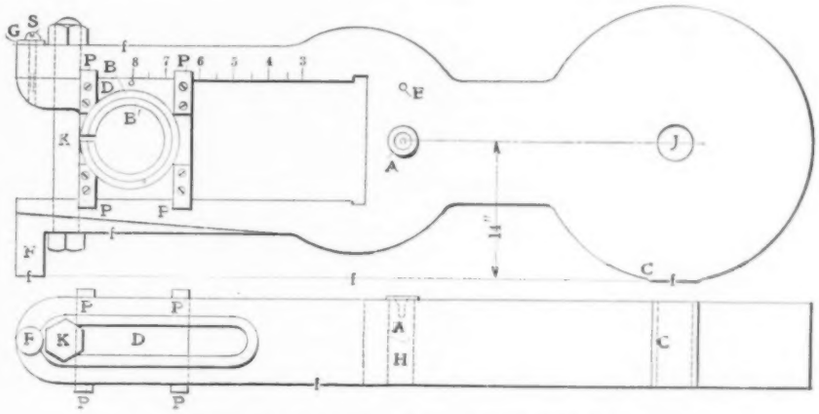
But the foundry boss was there with the goods all right. He went back into the foundry, got the hand bellows used by the molders to blow loose sand out of the molds, and then, when the rods were hot enough to weld, they were taken out and the boss pumped a stream of air onto those ends, while the superintendent stood and laughed; but pretty soon his face straightened up, and then he said: "Look out, Clem; go a little easy there or you will burn those ends off." In fact, Clem had them so hot, they had begun to drip iron. I have had this explained to me as being possible at a certain temperature; but if the iron is not hot enough when taken out of the fire, the blast will not have the desired effect. G. G. L.

[This action has become familiar in shops where welding is done in power hammers, and an air blast is used to keep the dies clean. Iron or mild steel heated moderately (not to a welding heat) is soon melted if held in the blast of air.—Ed.]

Adjustable Centers for Turning Crank Pins.

The illustration shows a jig for turning crank pins with from 3 to 8 inches throw.

The castings for this jig after being planed on the sides are clamped together to plane out the inside faces of the jaws; the bottom of the feet *F;* the finished flat bottom of the counterweight end *C;* and to bore the holes *H* which are bored all the way through and take the hardened steel bushings *A*.



ADJUSTABLE CENTERS FOR TURNING CRANK-PINS.

The sliding blocks *D*, after being planed on the sides, are clamped together for planing on the top and bottom and boring.

The guide plates *P* are fastened on with small screws as shown. The lug on the outside end of the sliding block has a tapped hole to receive the screw *S* which passes through the small plate *G* and a slot in the jaw, and clamps the block to the jaw, it is used to set the block to the throw of the crank, using the graduations on the jaw or block or dividers or trams from the center *E* to the center lines on the blocks. This is done before the jig is put on the crank shaft.

The hole *J* is used to attach additional counterweights when necessary. This end of the jig is made heavy for counterbalancing only.

In use the blocks are first set to the required throw of the crank, and with the crank-shaft upon a surface plate a jig is placed on each end of the crank shaft, the center of the pin is blocked up to the hight of the centers of the jig, and the nuts on the bolts *K* drawn down sufficiently tight to hold all the parts together firmly. If the crank shaft is smaller than the bore of the blocks one or more of the bushings *BB* may be used. The centers *A* are placed on the lathe centers, wood blocks are placed between the jigs and the crank webs, if necessary, to avoid any tendency to spring, and more weight is added to the counterbalance if necessary.

A crank pin will turn much better balanced in this way than with the counterbalance placed on the face-plate of the lathe, as is frequently done.

M. H. Ball.

Perpetual Motion at Last.

The 6—9 perpetual motion scheme recently shown by I. N. Ventor in your paper was sprung by me on a credulous public through the *Boston Journal of Commerce* just 24 years ago. I don't know whether that was its first publication or not; however, I sent it in as soon as I thought of it. Dixie is entitled to all the credit for his improvement at page 514 which would certainly increase the power. The only plan we could think of in the old days was to make figures larger.

Of course this isn't the first machine that "looked well on paper," but it's about the only one I remember seeing that was a *sure thing* (on paper).

Sterling Elliott.

The Need of Machinery.

This ugly business of raking the muck with a muck-rake should be stopped. The muck-rakers should lay aside the rake. They need a steam shovel.—*The Washington Star.*

Strength of Hydraulic Cylinders.

BY HARRY GUDHEIM.

The accompanying tables give the strength of hydraulic cylinders and are self explanatory.

Metrics in Parliament.

We published a short while ago an opinion by Mr. Moores, secretary of the British Weights and Measures Association, to the effect that it would be impossible for any headway to be made in metric matters during the life of the present British Parliament. Nevertheless,the Decimal Association of London seems to have hope that this is not the case. It informs us that 52 additional members of Parliament have, since Parliament re-assembled, expressed themselves in favor of the reform, and that with this new accession of strength there are now 320 votes to be relied upon in the Commons, and that early action is contemplated.

Sibley College Dinner.

The students of Sibley College, Cornell University, have adopted the excellent practice of holding an annual dinner. The event for this year was held in the University armory April 24, and was attended by 400 students and guests. Among the speakers were Professor Sweet, who had charge of the Sibley shop from 1873 to 1879; Walter C. Kerr and J. H. Barr, who are alumni trustees, and Professors Smith, Carpenter, Norris and Kimball, the first three of whom are graduates of the institution.

A Grinding Machine Driven by Chains.

We have received from Hans Renold, Limited, Manchester, England, a pamphlet illustrating the application of the Renold driving chain to a grinding machine which has been designed and is used in Mr. Renold's works for grinding long rods, which are afterward used in chain construction. The machines themselves are interesting, and Mr. Renold attributes their remarkable success as manufacturing machines to the use of chains for driving the wheel spindles and the other various motions required. One of these machines is used to grind rods from 0.325 to 0.75 inch diameter of any length to a limit of 0.0002 inch; a roughing and a finishing cut being taken off from each rod. The rods are 7 feet long and of the smaller ones the

Class A Machinery—NO SHOCK. Hydraulic Machinery worked by Hand Pump, Punching Bears, Jacks, etc.
" B " —SMALL SHOCK. Large rapidly worked Balling Presses, Accumulators with Safety Valves, Machinery working at a pressure from 1 to 4 tons per sq. in.
" C " —MEDIUM SHOCK. Hydraulic Goods Hoists, Cranes, Jiggers, Accumulators for pressure not exceeding 1500 lbs. per sq. in.
" D " —HOTEL LIFTS.
" E " —PUMPS WORKED BY POWER.
" F " —PUMPS WORKED BY HAND.

CAST IRON

INSIDE DIAMETER OF CYLINDER IN INCHES / CLASS OF MACHINERY	Working pressure in lbs. per square inch														
	A	400	650	800	950	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800
	B	330	530	670	800	1000	1300	1700	2000	2300	2700	3000	3300	3700	4000
	C	170	270	340	400	500	650	850	1000	1200	1300	1500	1700	1800	2000
	D	100	160	200	240	300	400	500	600	700	800	900	1000	1100	1200
	E	170	270	340	400	500	670	850	1000	1200	1300	1500	1700	1800	2000
	F	340	540	680	800	1000	1350	1650	2000	2300	2600	3000	3300	3600	4000
3		1/8	1/8	1/8	1/4	1/4	1/4	3/8	3/8	1 1/4	1 1/4	1 1/4	1 1/4	1 3/8	2
3 1/4		1/8	1/8	1/4	1/4	1/4	3/8	3/8	1	1 1/4	1 1/8	1 1/8	1 1/2	2 1/8	2 1/4
4		1/4	1/4	1/4	1/4	1/8	3/8	1	1 1/4	1 1/8	1 1/4	1 1/8	2 1/8	2 1/8	2 1/8
5		1/4	1/4	1/8	1/8	1/4	1	1 1/4	1 1/8	1 1/8	1 1/8	2 1/4	2 1/4	2 1/8	3 1/8
6		1/4	1/4	1/4	1/8	1/4	1 1/4	1 1/8	1 1/8	2	2 1/4	2 1/8	3	3 1/8	3 1/8
7		1/8	1/8	1/8	1/4	1/4	1 1/4	1 1/8	1 1/8	2 1/4	2 1/4	3	3 1/4	3 1/8	4 1/4
8		1/8	1/8	1/4	1/4	1	1 1/8	1 1/4	2	2 1/4	2 1/8	3 1/8	3 1/8	4 1/8	4 1/8
9		1/8	1/8	1/4	1/4	1 1/8	1 1/4	1 1/8	2 1/4	2 1/8	3 1/4	3 1/8	4 1/8	4 1/4	5 1/8
10		1/8	1/4	1/4	1	1 1/4	1 1/8	2 1/4	2 1/4	3	3 1/4	4 1/4	4 1/8	5 1/8	6
11		1/4	1/4	1/4	1	1 1/4	1 1/8	2 1/4	2 1/8	3 1/8	3 1/8	4 1/8	5 1/4	6	6 1/8
12		1/8	1/4	1	1 1/4	1 1/8	2	2 1/4	3	3 1/8	4 1/4	5	5 1/8	6 1/4	7 1/8
13		1/4	1/4	1	1 1/4	1 1/4	2 1/4	2 1/8	3 1/4	3 1/8	4 1/4	5 1/8	6 1/8	7	7 1/8
14		1/8	1/4	1 1/4	1 1/4	1 1/4	2 1/4	2 1/8	3 1/8	4 1/8	4 1/8	5 1/8	6 1/8	7 1/4	8 1/4
15		1/4	1	1 1/8	1 1/8	1 1/8	2 1/8	3	3 1/8	4 1/4	5 1/4	6 1/8	7 1/8	8	8 1/8
16		1/4	1	1 1/4	1 1/4	1 1/4	2 1/4	3 1/4	3 1/8	4 1/8	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4
17		1/4	1 1/4	1 1/4	1 1/4	1 1/8	2 1/8	3 1/8	4 1/4	5	5 1/8	7	8	9	10
18		1/4	1 1/8	1 1/8	1 1/8	2	2 1/8	3 1/8	4 1/8	5 1/8	6 1/4	7 1/8	8 1/8	9 1/4	10 1/4
20		1	1 1/4	1 1/4	1 1/8	2 1/4	3	3 1/4	4 1/4	5 1/4	6 1/8	8 1/4	9 1/8	10 1/4	11 1/4
22		1	1 1/8	1 1/8	1 1/4	2 1/8	3 1/8	4 1/8	5 1/4	6 1/8	7 1/4	8 1/4	10 1/4	11 1/8	12 1/8
24		1	1 1/8	1 1/8	2 1/4	2 1/4	3 1/8	4 1/4	5 1/4	7	8 1/4	9 1/4	11 1/4	12 1/8	14
26		1	1 1/4	1 1/4	2 1/4	2 1/8	3 1/4	5 1/8	6 1/4	7 1/8	8 1/4	10 1/4	12	13 1/8	15 1/8
28		1 1/8	1 1/8	2	2 1/8	2 1/4	4 1/4	5 1/4	6 1/8	8 1/4	9 1/4	11 1/4	13	14 1/8	16 1/4
30		1 1/8	1 1/4	2 1/4	2 1/8	3 1/4	4 1/4	5 1/4	7 1/8	8 1/4	10 1/4	12 1/8	13 1/4	15 1/8	17 1/8

UNHAMMERED STEEL CASTINGS

INSIDE DIAMETER OF CYLINDER IN INCHES / CLASS OF MACHINERY	Working pressure in lbs. per square inch											
	A	1600	2000	2400	2800	3200	3600	4000	4400	4800	5600	6400	8000
	B	1300	1700	2000	2300	2700	3000	3300	3700	4000	4700	5300	6700
	C	650	850	1000	1200	1400	1500	1700	1900	2000	2400	2700	3400
	D	400	500	600	700	800	900	1000	1100	1200	1400	1600	2000
	E	530	670	800	930	1000	1200	1300	1400	1600	1800	2100	2600
	F	1000	1300	1600	1800	2000	2400	2600	2800	3200	3600	4200	5200
3											1	1 1/4	1 1/4
3 1/4											1 1/4	1 1/4	1 1/4
4										1	1 1/4	1 1/8	1 1/8
5								1 1/8	1 1/4	1 1/4	1 1/4	1 1/8	2
6						1	1 1/8	1 1/4	1 1/8	1 1/8	1 1/8	1 1/8	2 1/4
7					1	1 1/8	1 1/4	1 1/8	1 1/4	1 1/8	1 1/8	2 1/4	2 1/8
8				1	1 1/8	1 1/4	1 1/8	1 1/4	1 1/8	1 1/8	2 1/4	2 1/8	3
9			1	1 1/4	1 1/4	1 1/8	1 1/8	1 1/4	1 1/4	2	2 1/8	2 1/8	3 1/4
10			1 1/8	1 1/4	1 1/8	1 1/4	1 1/4	1 1/4	2	2 1/4	2 1/4	2 1/4	3 1/8
11		1	1 1/4	1 1/8	1 1/4	1 1/8	1 1/4	2	2 1/4	2 1/8	2 1/8	3 1/4	4
12		1	1 1/4	1 1/8	1 1/8	1 1/4	2	2 1/4	2 1/8	2 1/4	3	3 1/8	4 1/4
13		1 1/8	1 1/8	1 1/4	1 1/4	1 1/4	2 1/4	2 1/8	2 1/8	2 1/4	3 1/4	3 1/4	4 1/8
14		1 1/8	1 1/8	1 1/8	1 1/4	2	2 1/4	2 1/4	2 1/8	2 1/4	3 1/4	4	5
15		1 1/4	1 1/4	1 1/4	2	2 1/4	2 1/8	2 1/8	2 1/4	3 1/8	3 1/8	4 1/4	5 1/4
16		1 1/4	1 1/4	1 1/4	2	2 1/4	2 1/4	2 1/8	3	3 1/4	3 1/4	4 1/4	5 1/8
17		1 1/8	1 1/8	1 1/4	2 1/4	2 1/8	2 1/8	3	3 1/4	3 1/4	4 1/4	4 1/8	6
18		1 1/8	1 1/4	2	2 1/4	2 1/4	2 1/4	3 1/4	3 1/8	3 1/8	4 1/8	5	6 1/4
20		1 1/4	1 1/4	2 1/8	2 1/4	2 1/4	3 1/4	3 1/8	3 1/4	4	4 1/4	5 1/4	7
22		1 1/8	2	2 1/8	2 1/4	3	3 1/8	3 1/4	4	4 1/8	5 1/4	6	7 1/8
24		1 1/4	2 1/4	2 1/4	2 1/4	3 1/4	3 1/4	4	4 1/8	4 1/4	5 1/8	6 1/4	8 1/4
26		1 1/4	2 1/8	2 1/4	3 1/4	3 1/4	4	4 1/8	4 1/4	5 1/4	6 1/4	7 1/4	9
28		2	2 1/4	2 1/4	3 1/8	3 1/4	4 1/4	4 1/8	5 1/4	5 1/4	6 1/8	7 1/8	9 1/8
30		2 1/4	2 1/8	3 1/4	3 1/4	4	4 1/4	5	5 1/4	5 1/4	7	8 1/4	10 1/4

TABLE I. THICKNESS OF HYDRAULIC CYLINDERS IN INCHES.

machine grinds from 50 to 60 per hour, and of the larger ones 35 to 45 per hour. The grinding-wheel spindle makes from 1150 to 1500 turns per minute, giving a chain speed of 1200 to 1550 feet per minute. The emery wheel is 16 inches in diameter, the chain is 2 inches wide and runs over a sprocket wheel 4 inches in diameter upon the wheel spindle.

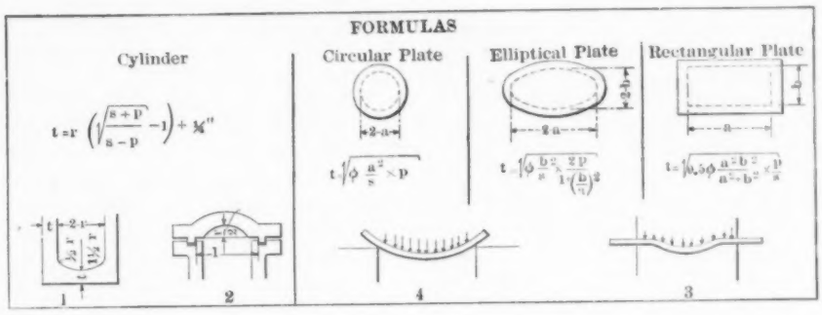
The present boom in the machine-tool trade is reflected by the fact that the Pratt & Whitney Company has under way additions to the plant in Hartford, which will about double the machine-shop capacity and will also double the foundry capacity. The old foundry has been demolished and a new one erected on the opposite side of the railroad, the plan being to extend the machine shop along the street to the railroad, and eventually back along the line of the railroad to join with the present building. A tunnel will connect the new foundry with the machine shop, so that castings may be taken across through this tunnel under the railroad.

The United States Civil Service Commission announces an examination on June 13, 14, 15, 1906, to secure eligibles from which to make certification to fill two vacancies in the position of mechanical draftsman in the Ordnance Department at Large, Rock Island, Ill., at $1200 per annum each, and vacancies as they may occur in any branch of the service requiring similar qualifications. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 1312. No application will be accepted unless properly executed and filed with the Commission at Washington. In applying for this examination the title Mechanical Draftsman Ordnance Department at Large, June 13, 14, 15, 1906, should be used in the application.

A well known engineer who has been a contributor to our columns, and who lives in the vicinity of San Francisco, expresses it as his opinion that the earthquake will turn out to have been a good thing for the city in the end He says also that public affairs are very poorly administered in San Francisco; that the fact is that the water supply had been shut off two days before the earthquake to make repairs, and that it was this shutting off of the water which caused the disastrous fire. San Francisco water is supplied by a private company, whose dam was visited by the members of the A. S. M. E., who went to California in 1892.

In our account of the things seen in the shops of the G. A. Gray Company, in Cincinnati, and which account was published at page 604, we mentioned George Marks, as being connected with the Gray establishment. This is a mistake due to what we hope is only a temporary aberration of mind. George Marks is a well known machine tool man, located in Springfield, while Henry Marx is at the head of the G. A. Gray Company. We have known both for many years and can imagine no reasonable excuse for having gotten their names mixed up.

It is stated that the nickel mines in Canada produce more of this metal than all the rest of the world.



t.—Thickness in in.

r.—Inside radius of cylinder in in.

s.—Allowable working stress in lb. per sq. in.

In considering the safe working stresses, as given below, it is supposed that the metal is stressed in one direction only but that the stress is applied and removed continually in the ordinary working of the machine. If the load is applied alternately in opposite directions, one-half of the stresses given below should be taken as safe working stresses.

ALLOWABLE WORKING STRESSES.

	Cast Iron.	Wrought Iron. Ordinary.	Wrought Iron. Roll'd Bars	Steel Cast.	Steel Forg.	Gun Met.	Mall. Iron ¾" Thick.	Phosphor Bronze.
Ult. Str.	18,000	40,000	50,000	48,000 to 86,000	60,000	24,000	36,000	38,000
A	6,000 to 7,500	10,000 to 19,000	19,000	14,400 to 17,000	20,000 to 22,000	8,000	16,000	14,000
B	5,400 to 6,300	10,000	13,200	11,300 to 14,000	13,200	5,200	10,600	9,200
C	2,700 to 3,100	5,300 to 8,000	6,600 to 10,000	5,700 to 7,200	6,600 to 10,000	2,600 to 4,000	5,200 to 8,000	4,600 to 7,000
D	1,600 to 1,900	4,000	5,000	3,500 to 4,200	4,500	2,000	4,000	3,500
E	2,700 to 3,000			4,600 to 5,500		4,000		7,000
F	5,500 to 6,300			8,700 to 11,000		5,300		9,300

Class of Machinery.

Note. With best material and workmanship the higher values may be used.

Note. There is a greater equality of stress in the cylinder walls, than above formula would indicate. It may therefore be justified to use a higher value of *s* the heavier the cylinder.

CLASSIFICATION OF MACHINERY.

CLASS A. *No Shock*—Hydraulic machinery worked by hand pump, hydraulic punching bears, hydraulic jacks, and similar small tools.

CLASS B. *Small Shock*—Large rapidly worked Balling presses, accumulators with safety valves, hydraulic machinery working at a pressure from 1 to 4 tons per sq. in.

CLASS C. *Medium Shock*—Hydraulic goods hoists, cranes, jiggers, and accumulators for pressures not exceeding 1500 lb. per sq. in.

CLASS D. *Hotel Lifts.*

CLASS E. *Pumps worked by power.*

CLASS F. *Pumps worked by hand.*

Note. The allowable stresses are taken from "Hydraulic Power Engineering," by Croydon Marks.

p=Internal working pressure in lb. per sq. in.

a and *b*=Dimensions in in. (see Fig.).

ϕ=Coefficient.

ϕ varies between following limits depending upon the kind of joint.

ϕ=0.8 if the plate is fixed at the circumference as shown in Fig. 3.

ϕ=1.2 if the plate is supported at the circumference as shown in Fig. 4.

Note. Flat cylinder ends are only suitable for small sizes and low pressures, owing to their great thickness for moderate strength. For large cylinder ends the dished form should be used as shown in Figs. 1 and 2. When there is a joint as in Fig. 2 the thickness of the cover should be the same as the sides of a cylinder of diameter *l*.

TABLE 2. STRENGTH OF HYDRAULIC CYLINDERS AND COVER PLATES.

Eleventh Annual Convention of the National Association of Manufacturers.

The eleventh annual convention of this association was convened at the Waldorf-Astoria of this city, Monday, May 14, at 2:30 p. m. In the enforced absence of Mayor McClellan, the address of welcome was delivered by Corporation Counsel Delaney, after which and a brief reply to it by President Parry, the formal business of the convention was opened by the appointment of committees on Rules and Order, Resolutions and Credentials. Following this the annual report of the president was read, which was largely in the nature of a retrospect and dealt with what the author termed "industrial buccaneers" in which term he included capitalistic and trade-union buccaneers. This portion of the report concerned itself to a great extent with the importance of individualism and its preservation.

Other subjects discussed were railroad-rate legislation and the legislative work of the association. Under railroad-rate legislation it was pointed out that a number of rebate cases had been successfully prosecuted in recent months. The necessity for stamping out the rebate evil, and for compelling the railroads to refrain from charging unreasonable or discriminating rates was also enlarged upon. The Senate debate on rate legislation was held to be one of the greatest in the country's history.

At the conclusion of the report the president announced that he must refuse to allow his name to be considered in connection with that office for the coming year.

Next in order of business was the treasurer's report, which showed the income of the association during the past year to have been $152,000, while as the result of the year's operations, the cash in the treasurer's hands had increased about $5000.

Following the treasurer's report came the report of the Committee on Pure Food, which began by saying that a national pure food law has become a necessity. The subjects to be considered in framing such a law are adulteration, the use of preservatives and the use of artificial coloring substances, regarding all of which there are many difficulties. In connection with preservatives, especially, they are, in some cases, necessary, and it hence becomes necessary to define those that are harmful and those that are not. Again in the use of coloring substances their use has long been established in, for instance, the butter industry, colored butter being preferred by the public, and in so far as such substances are harmless there seems to be no objection to their continued use. On the other hand, there is no doubt that the coloring substances used in connection with some food products are harmful.

The report concluded by recommending the appointment of a commission to consider proposed legislation, the commission to consist of a bacteriologist, a pathologist, a toxicologist, a pharmacologist and two manufacturers of food products. The report was referred to the Committee on Resolutions.

Following this came the report of the committee on National Incorporation, which had made a report on the same subject at the Atlanta convention of last year, since which no progress toward a national incorporation law has been made by Congress, but the committee believes nevertheless that the tendency toward some kind of Federal control of corporations is making progress. There seems, however, to be greater prospect of this control being exercised through Federal license than through Federal incorporation, because, under the rights of the States as secured by the Constitution, Federal incorporation must apparently be voluntary. Federal license would include the right of examining and auditing books. The report concluded that State legislation to remedy the abuses that have arisen in corporation management could not be expected and that some sort of supervision of corporations by the Federal Government had become necessary. In spite of the many difficulties of the subject the committee expected to see a satisfactory solution of it.

TUESDAY MORNING SESSION.

This session opened with the report of the Committee on Irrigation, which began with a note of congratulation over the progress of the movement as shown by the opening of an irrigation project in Nevada, containing 300 miles of canals and 50,000 acres of land. The Irrigation Commission has now investigated the irrigation possibilities in sixteen States and Territories and $28,000,000 have been appropriated for the work, while work has been begun on 14 projects, which, it is anticipated, will exhaust the funds available during the next ten years. The report pointed out the danger of conflict between the interests of private irrigation projects and projects under consideration by the Government, and there are already signs of this difficulty, due to the withdrawal of vast areas of the public lands from settlement. The work is of such vast importance and magnitude that it can only be consummated by Government agency, but at the same time there is no reason why Government and private work should not be carried on side by side.

The success of irrigation will alter the entire agricultural aspects of the West. Vast areas are not capable of irrigation and must continue to be used, as now, for stock raising. Large areas have been illegally fenced for this purpose, making a change in the land laws imperative. The problem is to preserve those lands which cannot be irrigated for ranches and also to provide for winter feeding of stock which now, in some cases, is very expensive. The report recommended that the semi-arid lands be leased to those who have taken up homesteads of irrigated land in the immediate vicinity. As a matter of fact this practice is already followed in the case of the State lands of Texas, while other Western States follow the practice of leasing their lands. It was considered that this practice would do much to prevent land frauds.

Following this came a report of the Committee on Industrial Education, which congratulated the association on the progress made during the past year. Philadelphia and Boston are making efforts to establish trade schools as part of their public school systems and several trade schools have been established. The New York Trade School has nine hundred students, with more applicants than can be accommodated, and new courses have been recently added. A trade school has been established in Milwaukee, which started off with 125 students and is entirely successful. Reference was made to the projected trade school for white boys at Gadsden, Ala., to an established school in Indianapolis, to one which is to be established at Palo Alto, Cal., and to the Ohio Mechanics Institute, as well as to the project for co-operation between the University of Cincinnati and the factories of that city, to which reference has been made in our columns. A bricklaying school, supported by the employing bricklayers of Cleveland, was also mentioned, and the Tuskegee Institute was referred to in complimentary terms.

The report was discussed at considerable length, Mr. King calling especial attention to the Indianapolis trade school. Among the subjects taught there are lithography, printing, electrical wiring and patternmaking, and as a result of a visit by a committee of the National Founders Association an appropriation has been made for a school of founding. The school of lithography has been especially successful. It has a waiting list of applicants for places in the school as well as applications for all the boys that can be turned out. Mr. Tabor and Mr. DuBrul made reference to the plans of the University of Cincinnati, and stated that Cincinnati had appropriated a million dollars for a new technical high school. Plans are also maturing for connecting the work of the Ohio Mechanics Institute with the shops of Cincinnati on a plan similar to that which is to be followed in the case of the University of Cincinnati. In both cases the half-time school idea of Professor Higgins is to be used, the boys being paired and each one of a pair working in the shop one week and attending school the next. The work of the Philadelphia trade schools was also enlarged upon. That city has had manual-training schools as a part of the public-school system for the past twenty years, and both Girard College and the Spring Garden

Institute have done excellent work for many years. A member from Columbus, Ga., stated that that city has had industrial schools for several years, and that a large mechanical school is now in process of construction. Mr. Maywood explained how some institutions founded originally by the State of Tennessee as reformatories have come to be industrial schools. J. A. Emery made an extended address on the necessity for industrial education; and Rev. J. R. McMullen of Gadsden, Ala., made an extended address on the plans of the trade school in that town.

TUESDAY AFTERNOON SESSION.

This session opened with a brief report of the Committee on Postal Affairs, which report explained that the committee was of such recent origin that it had not had time to do much effective work. It referred to the proposed consolidation of third- and fourth-class mail matter and to the commission recommended by the Postmaster-General to take up the question of second-class mail matter. The laws relating to second-class mail matter are admitted to be out of date, and the report of the commission should be awaited before the association takes action on the subject.

Next came the report of the Committee on Tariff and Reciprocity. Following an appointment by the president of the association the members of the committee attended the Reciprocity Conference at Chicago as delegates. The committee has drawn up in tabulated form a classified statement of the members in connection with the tariff schedules and their interest therein, together with their foreign trade. Germany has delayed the application of the new tariff for a year, but conditions with that country are nevertheless unsatisfactory, and the same is true with respect to Canada. The committee had also prepared some resolutions on the subject, but as these were not formally a part of their report they were referred to the Committee on Resolutions without reading.

Next came the report of the secretary, which, being in type, was not read. It outlines the activities of the association during the past year in opposing legislation at Washington and gives at some length a statement of the operations of the Legal Department and of the Foreign Freight Trade Bureau of the association.

At this point Mr. Ripley referred to the former services of Theodore C. Search, as president of the association during the first six years of its life, and made a motion to the effect that he be elected an honorary member, and after some discussion this was done with an enthusiastic rising vote.

Next came the report of the Committee on Interstate Commerce, which referred to the resolutions passed at the last convention, which recommended public accounting by railroad companies and increased powers for the Interstate Commerce Commission. The report indorsed the Hepburn bill as originally introduced and regretted that it had been changed, although it considered the bill as it now stands capable of much good. The report stated that railroads have become practically a monopoly and that their accounts should be subject to inspection. Since the date of the last report the subject of private cars and elevator charges have become of increased importance. Today competition has largely disappeared from the operation of railroads, and in some cases, notably the carrying of "tidewater" coal to New England, the charges for transportation have, during recent years, materially increased. The most serious discriminations in railroad rates today are in those rates as published and not in illegal departures from them. Experience shows that the right to sue railroads in case of discrimination has amounted to nothing. The report considers that there is nothing to fear from the passage of the Hepburn bill. Laws similar in effect to that bill have long been in force in England, and without resulting in injustice to the railroads, and in Canada a commission has long had control of railroad rates. The association has been polled on the subject of supporting President Roosevelt in this matter, the result being a total of 722 affirmative and 165 negative votes. The report concluded by recommending an appropriation of $10,000 for next year for the purpose of attending to the traffic difficulties of members, but this resolution was amended by making it a recommendation to the Board of Directors with power to act in their discretion.

Following this came a report of a former Committee on Merchant Marine, but on objection by a member it was ruled by the Chair that the committee was no longer in existence and that the report was out of order. After this a motion was carried directing the Chair to appoint a committee of one to attend a hearing before President Roosevelt, May 17, in advocacy of the pending bill for the promotion of an American merchant marine. Following this came some resolutions from the Resolutions Committee, all of which were passed. The first of these directed the officers of the association to make demand upon the proper authorities to prosecute the officers and members of all combinations of capital and labor whenever their acts contravene the law; the next indorsed the bill for the promotion of the American merchant marine, which has already passed the Senate; the next was an indorsement of the National Citizens Industrial Association; the next recommended that so far as practicable American materials be used in the construction of the Panama Canal, and the last indorsed the aggressive policy of retiring President Parry and directed the continuance of the same policy by the incoming administration.

WEDNESDAY MORNING SESSION.

The concluding session of the convention opened with the report of the Committee on Nominations, which placed in nomination J. W. Van Cleave, of St. Louis, as president, and Francis H. Stillman, of New York, as treasurer. These selections were so satisfactory to the members that the secretary was directed to cast one ballot for each. Following the election a resolution was passed thanking retiring President Parry for his four years of devoted service to the association and it was ordered that an engrossed copy of these resolutions be presented to Mr. Parry.

Following this came an address by Dr. W. H. Wiley, of the Department of Agriculture, on Pure Food. Dr. Wiley's address was the opposite of alarmist in its nature. He stated the chief abuses in connection with food products to be first the addition of injurious substances, either as preservatives or in order to improve upon nature in the matter of color, and second in the use of misleading labels, which latter he said was especially frequent on imported articles of food. There is much uncertainty regarding the effect on health of some of the preservatives that are used, especially when the small amounts used are considered, but he felt that in cases of this kind the consumer should have the benefit of the doubt. Regarding the use of artificial coloring matters, he stated that there is a tendency among manufacturers to do away with their use.

Following the address came another series of resolutions from the Committee on Resolutions. The first of these gave it as the sense of the association that a Federal food law is desirable, but that rulings under it should not be in the hands of any one man. The resolution further indorsed the pure food bill which has just passed the Senate. The next resolution recited that trade schools have become a necessity and recommended individual support of them by members; the next recommended a proper system of leasing public lands—the areas to be leased to be limited to small holdings, and the next related to tariff reform and reciprocity, which the preamble asserted to have become paramount issues. The resolution directed that a referendum vote be taken among the members in order to learn just where the association stands upon this important matter.

The report of the Committee on Consular Reform was then presented, and it consisted chiefly of the report of the National Consular Reform Association, which it was asserted was able to handle this important matter.

At this point Mr. Metcalf of the Tariff and Reciprocity Committee asked as a courtesy to that committee that its recom-

mendations which during yesterday's session had been referred to the Committee on Resolutions be read before the convention. At this point Mr. Tompkins arose and moved that the next convention be held in St. Louis, which resolution was carried.

The resolutions of the Tariff and Reciprocity Committee were then read. In discussing them Mr. Tompkins doubted if the members appreciated as they should the importance of the matter. While a thorough protectionist, he was not one of those who opposed all change, and he believed that 80 per cent. of the American people look upon the matter in the same way. He considered that the stand-patters comprised about 10 per cent. of the public and the free traders about the same percentage. If the revenues of the country are to be raised by a tariff, he had no fear that ample protection would not be provided. He favored a permanent tariff commission which could recommend changes in individual schedules from time to time and thus avoid the necessity for a wholesale revision of the tariff with the business upheaval consequent upon it.

Mr. Metcalf pointed out that every member of the Tariff and Reciprocity Committee is a protectionist, but that they recognized change to be imperative. Mr. Bigley, a member of the committee who had refused to sign the report, could see no reason why, in these piping times of prosperity, the tariff question should be opened at all. As a result of the discussion, it was voted that the report of the Tariff and Reciprocity Committee be received and placed on file—a procedure which the stand-pat element of the association had endeavored to prevent.

The convention was then addressed by George H. Ellis, president of the United Typothetæ of America, on the printers' strike which is still nominally in existence. He claimed the employers to have won far beyond their most sanguine expectations and explained the contrary statements of the Typographical Union, by saying that in the statements of the union regarding the proportion of their members who have the eight-hour day, the figures included the printers employed in the newspaper offices, who had long had the eight-hour day, and who were not engaged in the strike at all. So far as the struck shops were concerned the employers had won. He emphasized the necessity for open-shop employers standing by one another in a very material way, and suggested that the printing of such employers should go to open-shop printing offices.

Mr. Hermandine, Commissioner of the National Founders Association, then addressed the association regarding the recent walk-out of a large number of molders, due to the refusal of the employers to continue to make agreements with the union. He said that as the result of several years' practice in making these agreements it had been found that the union would not keep them, and that the association had recommended to its members to discontinue the practice.

Following this, the president announced the appointment of D. A. Tompkins to represent the association at the hearing before President Roosevelt on the bill for the promotion of the merchant marine.

Resolutions were then offered from the Committee on Resolutions, indorsing the action of the employing printers and the employing foundrymen in connection with the recent strikes, both of which were carried. A third resolution from the committee indorsed the action of the Postmaster-General in recommending a commission to investigate the subject of second-class mail matter.

After the passage of this and a complimentary set of resolutions for the retiring officers, the convention adjourned.

The banquet of Wednesdav evening at the Waldorf-Astoria was well attended, the great ball room being filled, with many ladies in the boxes. Addresses were made by several public men, Secretary of War Taft making a plea for free trade with the Philippines, and Admiral Coghlan urging the necessity of a merchant marine as a feeder for the navy. Charles E. Hughes spoke on corporate management.

Willans & Robinson's use of the Metric System.

Our readers will recall that we and others taking part in the metric discussion have frequently referred to the practice of Willans & Robinson, of Rugby, England, who, according to the testimony of Mr. Briggs, of their engineering staff, and of Captain Sankey, their works manager, were doing without difficulty most of the things that it was being declared, by opponents of the metric system, were impossible.

It will be recalled also that at page 496, we published the statement of Mr. Moores, secretary of the British Weights and Measures Association, to the effect that Messrs. Willans & Robinson had abandoned the metric system, and that they would hereafter lay out all new work to the inch-pound system instead of the metric. As we considered this matter to be of especial importance to our readers and to machine constructors everywhere, we addressed a letter of inquiry to Messrs. Willans & Robinson as follows:

"It has been stated here, particularly by Mr. Moores, secretary of the British Weights and Measures Association, that you have stated that in future new work designed by you, it will be designed and made to the English system of weights and measures; and that you now perceive that you have made a mistake in adopting and using the metric system in the design and construction of certain sizes of your engines.

"As the subject of the metric system is being very much discussed here among machine constructors; as there are many of them who are anxious to get at the real facts of the case, and as we have been endeavoring to present these facts, so far as possible, we would like to be able to say whether the report as given above is strictly correct or not, and also, if we can, just what reasons have led you to your change of mind regarding this matter.

"We do not wish this information to use either in favor of or against the metric system. What we want is simply the result of your experience with it, and the reasons why you have concluded that it is wise to abandon it, and hoping you will favor us and your many other American friends in this way we are, very truly yours."

Under date of May 8, Mr. Peache, director of Willans & Robinson, sends us the following letter:

"Your letter April 20th. Mr. Moores' services are enlisted in opposition to the spread of the metric system of weights and measures, and naturally he makes the most of the results of an interview he had with us on the subject.

"It is true that in new lines of work designed by us we are now using the English system of measures; the system of weights—except for convenience of calculation—has been the English system all along.

"The metric system of measures was originally adopted by this company for two reasons; first, that we were then doing a considerable Continental trade, and by adopting the metric system for a new line of Willans engines then being designed, we gained a considerable trade advantage; secondly, it was considered by those then responsible for this business that the metric system had some practical advantages in convenience of calculation and design—clearness and conciseness in figuring of drawings—and further that it would before long be universally adopted.

"The present management, although appreciating the advantage of making machinery destined for the Continent to metric dimensions, and while also appreciating certain practical advantages to be gained by the adoption of a small unit like the millimeter and a decimal system, is satisfied after a long, practical trial that such advantages as are to be obtained by the use of the metric system in an English machine shop are too dearly purchased; and moreover the present management does not regard the universal adoption of the metric system as imminent.

"To begin with, we may say that *no* difficulty has been experienced in getting our men to work with the metric system, but we still all think in English measures.

"You don't pull out your foot-rule to see how much a sixteenth of an inch is, but you find almost invariably that a rule comes out to see what a millimeter

dimension looks like, or if the inquirer does not possess a rule he turns millimeters into inches in his head and then judges of the fitness of the proposed size.

"The millimeter is in itself a fairly convenient dimension (the centimeter does not count; we don't suppose one man in a hundred knows there is such a thing as a centimeter), but the tenth of a millimeter is no use to anyone. It is like the proverbial goose—too much for one and not enough for two. Consequently for clearances even on our metric work we always figure up the drawings in thousandths of an inch.

"Such lines of work as we already have laid out on the metric system we shall continue to work on that system; indeed it offers advantages in such work as steam turbines or other work requiring a multiplicity of small dimensions. We may even use it on certain classes of new work; thus, we are making the Diesel engine from Continental designs, and for convenience of transcribing drawings, and also with a view to interchangeability with Continental work, we are putting these engines through on the metric system.

"In the ordinary way, however, we are making new lines of work to English dimensions, and are satisfied that the adoption of the metric system by this firm has cost us a great deal in gages and special tools without affording an adequate return."

As Captain Sankey has been so often quoted in connection with this matter, and as he retired from the position of works manager with Willans & Robinson about a year ago, having been succeeded by Mr. Peache, we have asked him for a statement, which we have not yet received but hope to have within a short time.

The Exporting Merchants of England.

A class of English dealers who are not nearly so useful to American machinists as they might probably become are the merchant exporters. They are many thousands in number, and have business connections in all parts of the earth. About 700 of those in London are concerned especially with machinery. Add to these, numbers in Manchester, Birmingham, Liverpool, Bristol and Glasgow, and the total will fall not very far short of 1000. They are buying agents for houses in Australia, in all parts of Africa, in India, South America, China, Japan and the Crown Colonies, and are also independent merchants pushing business abroad wherever business can be had. Not a little of British success is due to the organizations they have set up, and they by no means confine their operations to British goods. Vast quantities of German, Belgian and Austrian merchandise pass through their hands as well as a quota of American goods. If the latter proportion is not larger, that is because Americans have not applied themselves seriously to attract orders in the quarter where these most abound. The financial arrangements of the best of these firms are admirable and by long experience their business is worked through with perfect smoothness. Naturally, the best shipping merchants are not those with whom accounts can be opened most easily. They look to their suppliers to give them some evidence of *bona fides*, and they deal preferably with firms they know well. Not all are thus exclusive, and among the hundreds of merchants who sell upon catalogs, or in response to the inquiries they are incessantly soliciting, are many who would gladly put American tools and machinery of suitable sorts in their regular lists.

While certain of these are buyers of everything between pick-axes and boilers, others are specialists in a few lines. There are, for example, groups of buyers who touch little machinery other than that for use on plantations or in agriculture. Others deal in large plants for irrigation, railroad, mining, gas-making or such uses. Again there are merchants whose chief concern is with pumps, fencing, galvanized iron, brewing, refrigerating, marine or electrical machinery. Most numerous are those who ship builders' and engineers' stores, plumbing and stone ware, and rolled bars, sheets and the like. A few devote themselves extensively to machine tools for wood and metal workings, and these firms keep virtually in full employment machine-tool makers in Keighly and Halifax, which are both towns of low wages and largely given up to making machines for what is known as the "merchant" trade.

The names of these merchants are not difficult to come at, thanks to the availability of such directories as "The Mercantile Year Book" published in London at 21 St. Helen's Place, E. C. They are in a position usually to pay cash against documents on shipment, and the question is how to approach them. No doubt something is to be done in some cases by the supply of advertising matter and by correspondence. The weakness of that approach is that competitors are knocking at merchants' doors more loudly and insistently. Every large engineering firm in Britain has its office in London or possesses an agent to push its claims on shipping and other buyers. Not all agents and not, indeed all merchants have a deep insight into technical matters, and the best way to impress the shipper is to call on him in person or by some direct emissary from headquarters. Explanations being made, and business being done on standard patterns, the attention of an agent subsequently may suffice. He is within reach to notify changes, to explain away difficulties, and to keep merchants alive to the fact of his principal's existence. The orders or "indents" from abroad come in by the weekly mail and their fate must be sealed either by prompt calling or by the outgoing mail, which leaves only a few days of margin.

To enable the representative to act quickly, a certain discretion must be allowed him, and he must have cable-code facilities so that rapid delivery may be effected on occasion. Granted that the none too easy task of finding a capable and energetic representative has been accomplished, Americans may hope to make use of the very wide-spread selling organization of English mercantile houses, and to gain outlets that could hardly otherwise be reached. The merchant is kept in close contact with the needs of foreign customers, not so much by verbose reports on the market as by the practical evidence of sales. Like some impatient English confrères, American engineers send a great quantity of postage and printing to waste by offering business in wrong quarters. Times out of number the futility has been protested of endeavoring to sell complicated and expensive machinery to people who lack the money to buy it, and the intelligence to work it, even had they the means. But apart from occasional mammoth orders, there is much to be hoped from the ingenious improvements and the accessory items that Americans have always been quick to devise. If they can induce the British merchant to put the advantages of these improved systems before his foreign correspondents, a field will be covered that is not reached quite so effectively by American commision houses or by efforts in direct trading.

For that matter, Americans are not confined to British shippers in their efforts to extend a connection. In Paris, Hamburg, Berlin, Bremen, Leipzig, Amsterdam, Rotterdam, Antwerp and even in Zurich, Basle, Genoa and Milan, merchant exporters reside, who all possess some special call on business in machinery in some distant part of the world. As a matter of mere prudence, it seems best that these buyers should not be left in total ignorance of goods that they may some day be asked for. And to sellers of a fairly diverse assortment of mechanical appliances, many a worse speculation might be commended than a diligent application to these sources of business. As they are in the habit of making strict terms with their own customers, merchant shippers are in a position to pay promptly themselves and that is more than can be said for many foreign buyers of whom one hears more.

J. A. H.

H——, England.

In cutting threads on copper or otherwise cutting copper in machine tools, there is sometimes difficulty in getting a smooth surface, and lubricating with milk is often useful, though ordinary mineral lubricating oil will sometimes have a good effect also.

AMERICAN MACHINIST

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Contents.

	PAGE
The National Bureau of Standards at Washington—II	663
Plant Inventory—Importance, Value and Method of Keeping a Going Inventory	670
A New English Lathe	671
Standard Hose Couplings	672
Museums of Security—Preliminary Announcement of an Exposition	673
Starting of an Allis-Chalmers Turbo-Generator in Brooklyn	676
Letters to the Editor: Repairing Worn Chucks....Making a Small Spring ....Another Thing that is Usually Wrong—Dovetails....Interchangeable Boring-Bar Cutters....Wooden Laps....Straightening Gun Barrels ....Graduating Dials with Progressively Varying Divisions....Shall We Patent Our Inventions?.... A Spring Threading Tool	677-681
The Need of Machinery	681
Strength of Hydraulic Cylinders	682
Metrics in Parliament	682
Sibley College Dinner	682
A Grinding Machine Driven by Chains	682
Eleventh Annual Convention of the National Association of Manufacturers	684
Willans & Robinson's Use of the Metric System	686
The Exporting Merchants of England	687
The Morton Memorial Volume	688
Trade Journalism	688
The English Language in China	688
Carl Schurz	689
An Alleged Substitute for Steel	689
New Publications	689
New Tools and Machine-Shop Appliances	690
Foreign Markets for American Machinery	691

The Morton Memorial Volume.

Under the head of "New Publications" in this issue will be found a description of a fine specimen of the art of book-making, the Morton Memorial volume of the Stevens Institute of Technology. We deem it well to advert here to the circumstances leading to the publication of this work, which, besides the importance it would naturally possess for the graduates of Stevens Institute, contains much information for those interested in the history of engineering in this country, and in the progress and performance of a representative technical school.

The origin of the book is due to the late President Morton, of Stevens, who several years before his death, planned to issue a souvenir volume of the 25th anniversary of the Institute of Technology, and who spent a large amount of time, principally in collecting the data regarding the engineering achievements of the Stevens family, and also spent a large amount of money, in the work. After his death in 1902, the alumni decided to issue the book as a Morton Memorial, which of course, necessitated some changes in its plan. The history of the Institute was expanded and the amount of space devoted to the anniversary celebration was cut down, the matter relating to the Stevens family and to the biographies of the trustees and faculty being substantially the same. It became necessary to add to the biographical sketches of the alumni in order to bring this portion up to date; it now contains the names of 1088 men who have received degrees, from the first in 1873 up to and including the class of 1904, the classes of 1903 and 1904, however, not being included in the biographical sketches. Great care has been taken to get this matter as accurate as possible, and we consider it as by no means the least interesting feature of the book. The historical and biographical matter in the other sections of the book is, it is safe to say, more complete than anything heretofore gotten together on those subjects.

Trade Journalism.

In the *Saturday Evening Post*, of Philadelphia, is an article by James H. Collins, entitled "The New Profession," in which he draws some interesting comparisons between regular newspaper work such as is done on daily and weekly newspapers, and that which is done upon technical, or trade papers. The differences between the two classes of work are of course very wide, an entirely different atmosphere pervades them, and the qualities which lead to success in the one field are usually of no value in the other. One of the prominent points of difference pointed out by Mr. Collins is in his statement that the daily newspaper does its work under such conditions that "the longer a man or woman works for it, the less he or she is worth to it." The trade journal, on the contrary, "puts a premium on stability. Talent it requires hardly at all; for the superficial writing that attracts and astonishes has no place in its editorial scope. The trade journal does not even aim to interest, for it already has an interested following that will read the dryest presentation of its especial kind of information. The more attractively such information can be served up, the better of course; but precocious writing is more likely to be repressed than stimulated." "Trade journalism is a field of special writing that tends to make workers more and more valuable to the journals they serve as the years pass." On a newspaper the most stable positions are those of specialists, such as sporting, financial, and literary editors. Trade journalism makes all its workers over into such specialists. The author touches interestingly upon the effect of the work upon the character of those who engage in it, and the article as a whole will be found interesting and instructive for those who care to know something of the difference between ordinary and special newspaper work.

The English Language in China.

Consul George E. Anderson, writing from Amoy, gives a very interesting account of the Chinese language and the various dialects of which it is made up. He states that the Chinese language is almost useless for a general commercial language, even within the boundaries of China itself, because there are so many dialects, and that the intercommunication between the Chinese themselves is greatly restricted by these dialects. He says that it will often happen that two Chinese working together in a Chinese port will be obliged to converse between themselves in English, both of them having learned something of this language, but not being able to understand each other's Chinese dialect. The opinion is expressed that English will become the commercial language of that country, for the reason that it is necessary that Chinese should come to a common language, and that so long as they have a new language to learn, they may as well learn one which will be useful to them in outside or foreign commercial operations. Mr. Anderson concludes by saying that at all events "a study of the Chinese language for commercial purposes by Americans is, in my opinion, unwise, unnecessary and unprofitable, but American business interests concerned in Eastern trade can with profit see to it that young Chinese men are given business education in the United States."

It seems almost incredible that it could happen that the Chinese people should learn a foreign language for the purpose of better communication between themselves, as well as for use in intercourse with foreigners, but the statement is so-

berly made by one who is on the ground, and evidently has given much attention to the matter. Who knows but that this may transpire to be one of the steps toward the universal employment of English as a commercial language which is prophesied by Prof. Brander Matthews and other advocates of reform in English.

Carl Schurz.

Carl Schurz was no engineer, and had nothing to do directly with mechanical matters. Nevertheless, it is such men as he who have laid the foundation and secured the conditions under which the wonderful industrial development of America has taken place. Industry thrives best under conditions of freedom and liberty, and Carl Schurz was a born lover of liberty. He believed in freedom for all men, whether Anglo-Saxons, Africans, or Filipinos. He believed with Lincoln that "no man is good enough to govern another man, without that other man's consent." Not only did he believe this, but throughout all his long life he showed an entire willingness to sacrifice his personal interests for that idea. He pre-eminently stood up for those things which he believed to be right, regardless of the effect upon his personal fortunes.

No one can read the account of his life, now running in *McClure's Magazine*, without being impressed by the man's extraordinary devotion to his sense of duty, and not only was he devoted to what he believed to be right, but by education and by careful thinking he qualified himself to judge betwen right and wrong. It is fortunate for America that the political conditions in Germany in 1848 made it impossible for Carl Schurz to remain in that country, and very few, either native or foreign-born citizens of this country, have done more to make it truly great, and to make the real and legitimate objects of government generally understood. The world is the better for Carl Schurz having lived in it. His unfaltering devotion to duty and to what he believed to be right has been and long will be an example and an inspiration.

An Alleged Substitute for Steel.

A man representing himself as being the agent of an English steel manufacturing concern, connected with an import and export company of New York City, is attempting to introduce what he calls a substitute for high-speed steel, used for cutting purposes in machine shops. He asks a high price for it, does not have with him samples sufficiently large to enable tests to be made, but only a piece about as big as his thumb for the purpose, as he says, of "showing the grain." It is, of course, evident that showing the grain will mean nothing in the case of a new material, and that the only way of proving the superiority of the new material is to make a test of it. This he proposes to have made only after an order has been given him for a bar of the material not less than six feet in length. His way of doing business has naturally aroused some suspicion among our friends, and we think with good reason.

New Publications.

"Morton Memorial: a History of the Stevens Institute of Technology, with Biographies of the Trustees, Faculty, and Alumni, and a record of the Achievements of the Stevens Family of Engineers." Edited by Franklin De Ronde Furman, M. E., Professor of Mechanical Drawing and Designing; with an introduction by Alexander Crombie Humphreys, M.E., Sc.D.,LL.D., President of Stevens Institute. Hoboken, N. J., Stevens Institute of Technology, 1905. xxii + 641 7¾x 11¼-in. pages; full-page photogravure pictures of Henry Morton and Edwin A. Stevens, half-tone pictures of nearly one-half the alumni, and in addition nearly 200 general illustrations. Heavy French morocco leather binding, gilded edges. Price $10, delivery charges prepaid in the United States.

The above is one of the handsomest books which have come to this office. We have referred elsewhere in this issue to the history of its production, and we give here merely a summary of the contents. It is divided into three principal sections, as follows:

Section 1. History of Stevens Institute. This includes an account of the 25th anniversary celebration, February 18 and 19, 1897, of the founding of Stevens Institute; and the dedication of the Carnegie Laboratory of Engineering, February 6, 1902.

Section 2. History of the engineering work of the Stevens family of engineers—John, Robert L., and Edwin A. Stevens. This section contains much original matter covering the early days of the steamboat (operated by John Stevens on the Hudson river in 1804, and on the ocean for the first time in 1809 by Robert L. Stevens); the steam railroad (operated on private track in Hoboken in 1826 by John Stevens, and in public service as the Camden & Amboy, now Pennsylvania Railroad, in 1831); the armored war-vessel (first to be placed under construction under United States contract by Robert L. Stevens, in 1842); and many mechanical devices, such as the present form of rail and spike used on steam railroads, the screw propeller, the multitubular boiler, and the use of steam expansively, and of anthracite in locomotives, etc., etc.

Section 3. Biographies of the trustees, faculty and the alumni of Stevens Institute. In the biographies of the faculty may be found a complete list of the writings of the late Dr. Morton, and Professors Alfred L. Mayer, R. H. Thurston, De Volson Wood, and A. R. Leeds; also of Professors C. W. MacCord, J. B. Webb, T. B. Stillman, J. E. Denton, D. S. Jacobus, etc. In the biographies of the alumni every graduate is included, and where obtainable, brief but complete records of positions held since graduation, with short descriptions of character of work done, patents taken out, scientific papers, and other facts of general interest. Portraits are shown of nearly one-half of the alumni.

The volume was issued upon an advanced subscription basis among the alumni, but there is a limited number of copies left over, which can be obtained for the price stated. We have no doubt but that the eminence of Dr. Morton, and the prominence of Stevens Institute and its graduated engineers will bring about a demand for this book among educators, engineers, libraries, etc., as soon as it becomes known that there are some copies available.

"Marine Boilers," Based on the work by L. E. Bertin. Translated by Leslie S. Robertson. Second edition. 658 5¾x8¾-in. pages, with 300 text cuts, and numerous full-page and folded plates. D. Van Nostrand Company, New York. Price $5.

This very complete and exhaustive work is from the French with, however, many additions by the English translator. As is to be expected in a book on this subject from French sources, a large amount of space is given to water-tube boilers with which, for marine purposes, French marine engineers have been pioneers. While fire-tube boilers are treated with fullness, it is probable that the publication of French practice with the water tube will be found to be the feature which will lead to the chief sale of the book among English and American engineers, as there is no other published account of that practice in book form, and especially because the author discusses the advantages and disadvantages of the water tube in its various forms with, apparently, entire fairness. Among the subsidiary phases of the subject discussed are natural and different systems of forced draft, liquid fuel, boiler mountings and fittings and feed accessories. The author is Chief of the Technical Service of the French Ministry of Marine and a distinguished engineer.

"Forty years an Advertising Agent," by George P. Rowell, 517 5½x8-inch pages; cloth. Printer's Ink Publishing Company, New York.

This book consists mainly of the personal reminiscences of its author and tells of many interesting things that have happened, chiefly in New York; and in many of which the author was himself a participant. It throws a good many side lights (and direct ones as well) upon the advertising business. Many amusing happenings are recorded also, but there is scarcely a more amusing thing about the

book than its index, which appears to have been constructed without the least reference to even the most elementary principles of indexing. Though very voluminous, if we exclude the utterly useless entries it becomes small. For instance, we find a string of entries under the article "A" such as "A country doctor would carry it in the form of a powder," which is not indexed under "Doctor" nor "Powder," nor in any way as an indexer would do it. There is also a long string of entries under the article "An" and everywhere entries are made under adjectives, adverbs, etc., as freely as under verbs or nouns. Nevertheless the book itself is an interesting one for those who have anything to do with the publishing business especially.

The publishers of *Compressed Air* call our especial attention to their May number, which appears in larger and more attractive form. The publishers state that they will appreciate a review and criticism of the paper. As to the review we can only say that the journal contains a number of very interesting articles on those branches of engineering in which compressed air and compressed-air machinery are used, and that the articles are presented in excellent form. In the way of criticism there is only one point; the enlargement has made the journal 7x10 in. We think that it should have been 6x9, or 9x12, the tendency of the times being toward standard sizes for technical publications. The editorial at page 4051, entitled "Jokes with Compressed Air," is taken from our columns without credit, but this is of course due to an oversight brought about by the somewhat unsettled state in which all journalistic offices are when changes are taking place. We are, however, by this publication the more convinced that the editorial is a good one, and that the lesson it seeks to instil should be as widely taught as possible.

"A chapter on Lettering." Second edition. 28 6x9-inch pages, with text cuts and plates. The Browning Press, Collingwood, Ohio. Price 25 cents.

This pamphlet gives practical hints on the formation of letters and includes several alphabets, both plain and fancy.

"Gasolene Engine Ignition," by E. J. Williams. 93 5x7-inch pages, with 37 illustrations. The Gas Engine Publishing Company, Cincinnati, Ohio.

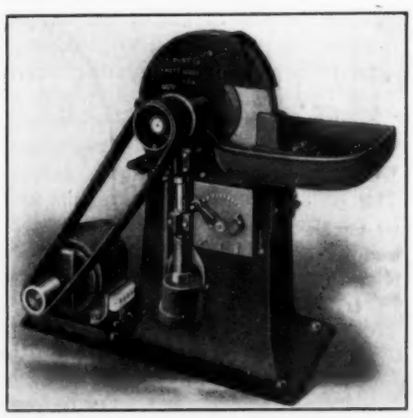
This little volume is intended to instruct operators of gasolene engines and more especially of motor boats in the principles and operation of the ignition apparatus. The make-and-break and the jump-spark apparatus are clearly described, and methods of testing for causes of trouble are given.

The electrolysis nuisance has become so serious in Pittsburg that the city and the Pittsburg Railways Company will jointly investigate with a view to saving the city's water mains.

New Tools and Machine Shop Appliances.

MOTOR-DRIVEN 20-INCH WATER TOOL GRINDER.

This machine is driven by a 2-h.p. motor by means of an endless belt to the pulley on the driving spindle; the motor being set on an extended base, provided with means for sliding the motor to tighten or loosen the belt, as desired. The rheostat is attached to the side of the machine, convenient to the operator. The grinder has self-oiling bearings, and is provided with a large deep pan, which conducts all surplus water back to the tank in the column; the water being applied to the wheel by means of a vertical centrifugal pump, which may be regulated by means of the valve at the left. The vertical pump shaft is driven by a friction wheel, which is held in contact with the edge of the main drive pulley. The bearings are mounted on a forked carrier, pivoted at its lower end; the upper end being secured between jaws, which hold the friction wheel in contact with the driving pulley. The pump vane is loosely fitted in a case of snail-shell design, and grit or coarse sand may pass through it without injury. A sleeve cap covers the pump case and prevents leakage without the use of packing; the water line always being below the top of the sleeve. A pan is set below the wheel and extends from the front to the back of the column to catch and prevent the dirt or grit from settling in the tank. The water from this pan passes to the tank below at the furthest point from the

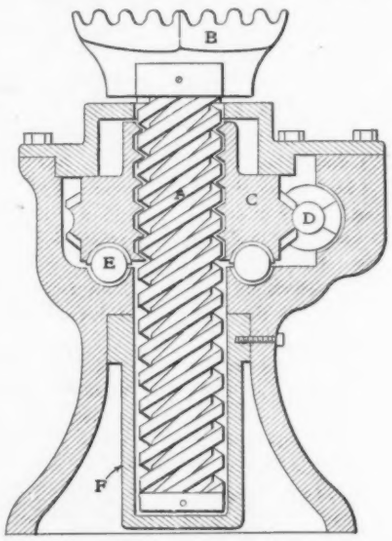


MOTOR-DRIVEN 20-INCH WATER TOOL GRINDER.

pump, and the tank is provided with a settling chamber, to catch and retain any grit that may have passed the pan. The tank is provided with a large opening at the right side, through which it may be cleaned when necessary. The hood which covers the wheel is brought well forward from the center to prevent water reaching the main bearings or flying upon the floor. This tool grinder will take wheels 20 inches in diameter, 2½-inches face, with a 9-inch hole. It is built by the J. G. Blount Company, Everett, Mass.

A BALL-BEARING JACK.

The illustration shows a jack equipped with ball thrust bearings. *A* is the lifting screw having quadruple threads. *B* is the head of the screw. *C* is a worm gear threaded to fit the screw *A* and recessed for the steel ball races in which the balls *E* run. These races are renewable in case of wear. *D* is the worm, the shaft of which is fitted with ball thrust bearings, and a reversible ratchet handle. *F* is a grease-pot filled with a suitable lubricant. The action of the jack is this: It is placed under the object to be raised, the head *B*, and with it the screw *A*, is



A BALL-BEARING JACK.

turned by hand until it is in contact with the object, the ratchet lever is then worked until the head *B* "bites;" it is then no longer necessary to hold *B* as the friction prevents it turning. The nut *C* turning on the screw *A* raises the load to the desired hight. In lowering, the ratchet pawls are reversed, the load is lowered until the head *B* is out of engagement with the object when, owing to the steep pitch, the screw *A* at once drops to its lowest position. The jacks are made in eight sizes—from 2 to 45 tons capacity—by the Acme Ball Bearing Company, Chappaqua, New York.

Those of our readers who are interested in life insurance will find in *Moody's Magazine* for May an article by Wm. A. Fricke, Ex-Commissioner of Insurance in Wisconsin, in which he deals with the present insurance situation, and declares that the legislation enacted as a result of the Armstrong Committee investigation, guided by Charles E. Hughes, is not at all satisfactory from the policy-holder's standpoint, but rather the opposite, and he points out what should be done in order to rectify matters. Another insurance expert has an article entitled "Hysterical Insurance Reform," and there are articles

on the Future of the Steel Trust, Federal License of Corporations, Humbugs Labelled "Business Opportunities", Southern Cotton Mills and Their Securities, The Wrong of Overcapitalization, etc., all written by men who have given particular attention to the subjects of which they treat.

Foreign Markets for American Machinery.

American engineering firms have not yet entered the Austrian market for the supply of boiler furnaces. These are not manufactured in the country, and hitherto most of these furnaces have been supplied from England, while a small proportion have been sent from Germany. As the Deighton and Morison patent flues are mostly used, the ratio of percentage between the United Kingdom and Germany is 85 per cent. of the former to 15 per cent. of the latter. Safety valves, cocks, valves, etc., for high-pressure boilers, say from 105 to 300 lb. per square inch, are constantly supplied to the various engine works from British makers, but in these articles there is great competition from both Austrian and German manufacturers, but of the total quantity required, 35 per cent. is of British manufacture. United States engineers might profitably seek for business in this market, as there is absolutely no reason for British preference, other than the suitability of the goods supplied. Marine boilers of high pressure for the important port of Trieste were in the past constructed only in the United Kingdom, but lately four cylindrical donkey boilers and two main boilers have been built at Graz, although a considerable order has been placed with British makers.

American hardware manufacturers exporting to South Africa should remember how essential it is to pack their goods properly. Even up to the present time large quantities of imported manufactures have to be conveyed by ox-wagons, and great losses are incurred through improper packing. As a rule goods should be packed in smaller cases than is customary with most firms. Of course the cheaper the goods (that is, the lower the quality) the larger the quantities in which they are made up. It is well, however, to point out that this is quite a mistake; and many persons instead of importing, either leave the item out of their indents or buy a small quantity (at ridiculously high price) from some of the coast houses, just for the sake of having the article if it is asked for. Of course you will readily see that this entails loss of business at two points; the price charged to the purchaser being high and the home merchant losing probably larger sales (in the aggregate). For packages going to the country per wagon, about 450 pounds ought to be maximum weight, but as many as possible should be, say, 200 pounds. That is for mixed goods. Another point is that for shipment and very rough handling, cases on the average, and particularly those destined for far up-country stations, ought to be made much stronger when their contents are heavy. Various kinds of hardware are especially troublesome in this respect, both as to outward and inward covering and packing, either in boxes or parcels. Many a time in bad weather a wagon gets stuck in a ford, and there is no getting away from there and proceeding on the journey until that wagon is unloaded where it stands and loaded up again high and dry on the opposite bank of the stream. Without appliances, and miles away from any habitation, it is clearly impossible for two men and a boy to shift huge cases.

Makers of oil engines and pumps would do well to note the trade that is springing up for oil engines and centrifugal pumps in Baghdad and throughout Palestine. The people in the former place are just beginning to awaken to the benefits arising from the use of machinery. The oil engines now being imported range from 6 to 25 horse-power and use the ordinary petroleum of commerce. Two French firms, one a maker of oil engines and another the maker of centrifugal pumps, began to push this trade about a year ago, and have up to the present sent seven engines and as many pumps. The trade is capable of very great development inasmuch as there are thousands of acres under artificial irrigation throughout the district, the system adopted being of a most primitive nature, employing many thousands of animals with hardly any remunerative result. There is a really good chance now for manufacturers to step in and do away with the present tedious system which is carried out by employing a horse to draw water from the river in a skin bag suspended over a pulley. A few people have already recognized the great advantages possessed by the use of an oil engine pump and the full development of the trade is only a matter of time and enterprise. The use of locally refined naphtha obtained from springs near Baghdad, if found practicable, will at once give a great impetus to the adoption of oil engines. They must be simply constructed, moderate in price, and supplied on easy terms of payment, quoting c.i.f. prices for both engines and pumps. The use of these engines is also steadily increasing in Palestine. They vary from 2 to 15 horse-power and are employed for very similar purposes. They were imported into Palestine originally from Germany about ten years ago, and since then the trade has developed, German and English manufacturers doing the bulk of the business. A good many are now employed in irrigating the orange gardens of Jerusalem, the majority of the engines required for such purposes being of from 3 to 4 horse-power. A good deal of the pioneer work in familiarizing the natives with mechanical power has already been done. At first no one would try the engines, but the makers offered to set up one free of expense by way of experiment. Of course it was so successful that orders flowed in at once. An initial difficulty of clogging with sand and mud at the bottom of the well has been overcome, and now the work is accomplished at less than half the cost formerly incurred. Within three years from their introduction over sixty of these engines were supplied to the larger plantations, of which two-thirds were of German make and the rest of British manufacture. As native labor has to be used it is absolutely necessary that the engines should be so constructed that they will successfully withstand somewhat rough handling, arising from unskilled use. F. C. C.

London, England.

Personal.

Charles T. Allen, secretary and treasurer of the Union Steam Pump Company, has sold out, resigned and proposes to rest up. Mr. Allen's pump industries have been very successfully managed.

H. C. Baker, formerly in charge of the Atlanta office of the Crocker-Wheeler Company, in which capacity he became favorably known as an electrical engineer throughout the Southern industrial field, has started for San Francisco, where he will take charge of the Pacific Coast territory of the company.

At the annual meeting of the Baush Machine Tool Company, held April 23, Edward A. Appleton was elected president, to succeed H. R. Dalton, Jr., who resigned; G. Frank Adams was elected vice-president; C. J. Wetzel, treasurer and general manager; F. E. Bocorselski was elected superintendent.

Ralph B. Hayward has resigned his position as manager of the Pittsburg office of B. F. Sturtevant Company, to accept the management of the Chicago branch store of the Buffalo Forge Company, with which company he began his career in the fan business. Mr. Hayward enters upon his new duties June 1.

Arthur J. Vance, superintendent of the Southern Engine and Boiler Works at Jackson, Tenn., will assume charge of the Buffalo Forge Company's interests in the Cincinnati district on June 15. Mr. Vance was formerly Cleveland manager for the Buffalo Forge Company, but was compelled to resign that position on account of illness due to an unfavorable climate, and from which he has fully recovered since his location in the South.

Obituary.

Gustav Fuchs, founder and head of the Gustav Fuchs Iron Works, New York City, died at his home in Brooklyn, May 12. Mr. Fuchs was 54 years old, and had been in the iron foundry business for 25 years.

Thomas L. Higgins, for many years the proprietor of the Watt Iron Works, died at his home in Brooklyn, N. Y., May 12. Mr. Higgins was born in Ireland. During the Civil War he was chief engineer of a transport, and aided in cutting the chain blockade across the Mississippi river. He retired from business several years ago.

Business Items.

Albert B. Curtis, 10 Loudon street, Worcester, Mass., formerly of the Reed & Curtis Machine Company, that city, has withdrawn from that company and is now manufacturing oil separators. These separators are the same as heretofore built by the Reed & Curtis Machine Company, he having taken over that end of the business.

The O. K. Tool Holder Company, Shelton, Conn., because of its rapidly increasing business, is erecting a four-story fireproof factory. This will be completed during the summer and will more than double the present capacity of this company. This company has recently gone into the drop-forging line and is about to erect a steel drop-forge plant.

Manufacturers.

The Worcester (Mass.) Steel Foundry will have an addition built.

Central Foundry Company, Detroit, Mich., will build an addition.

The Omaha (Neb.) Safe and Iron Works is building an addition to its plant.

El Paso (Texas) Foundry and Machine Company will erect a new plant.

The Queen Dyeing Company, of Olneyville, R. I., intends to build a new mill.

The Baldwin Locomotive Works will erect extensive buildings in Eddystone, Pa.

The East Liverpool (Ohio) Machine and Foundry Company will erect a new plant.

The Foster Machine Company, Westfield, Mass., will build an addition to its plant.

The Butte (Mont.) Street Car Company is erecting an addition to its machine shops.

The Eclipse Gas Stove Company, Rockford, Ill., will build a two-story addition to its plant.

The Gunnell Machine Company, Manitowoc, Wis., will double the capacity of its plant.

The Mason Manufacturing Company, wood novelties, South Paris, Me., will build a new plant.

Conant, Ball & Co., chair manufacturers, Gardner, Mass., are building a four-story addition.

The Morley Twine and Machinery Company, Sioux City, Iowa, is building a new factory.

The F. R. Patch Manufacturing Company, Rutland, Vt., is having additions to its foundry built.

The Philadelphia & Reading Railway Company will erect a new power house at Neshaminy Falls.

The Vacuum Cleaner Company, of New York, will erect a plant in North Plainfield, N. J.

Plans are being made for a machine-tool building for the Buckeye Engine Company, Salem, Ohio.

The Baltimore & Ohio Railroad will rebuild the shops destroyed by fire at Keyser, W. Va., on a larger scale.

The Ozone Lumber and Building Supply Company, Covington, La., has decided to add a sash, blind and door factory.

Ground has been broken for the proposed electric plant of the Wilmington (Del.) Light, Power and Telephone Company.

The Potomac Electric Telephone Company, Washington, D. C., has been granted a permit to erect a $100,000 power-house.

The Felt & Tarrant Manufacturing Company, Chicago, Ill., manufacturers of comptometers, will erect a new factory.

The Wilmington (Del.) City Railway Company has taken out a permit for an addition to its power house to cost $18,000.

The American Woolen Company, Providence, R. I., has decided to erect a new plant at the Riverside Mills in Olneyville.

The American Steel and Wire Company will build additions to its works in Quinsigamond, R. I., at a cost of $109,000.

A woolen-yarn plant, consisting of factory and power-house, will be erected in Camden, N. J., for the B. F. Boyer Company.

The Solar Glass Company has been incorporated at Owensboro, Ky., and will erect a glass factory at once. Capital, $50,000.

Specifications are being prepared for new factory buildings for the L. S. Starrett Company, tool manufacturers, Athol, Mass.

The Sefton Manufacturing Company, Chicago, Ill., which makes wooden dishes and paper novelties, will build a new plant.

It is understood that plans are being drawn for new foundry buildings for the William E. Hill Foundry Company, Kalamazoo, Mich.

A four-story addition will be built to the plant of the Watson & Newell Company, Attleboro, Mass., jewelers and silversmiths.

The saw and stave mill of the Rockland and Rockport Lime Company at Rockland, Me., was destroyed by fire. Loss $15,000.

The Francis Hook and Eye and Fastener Company, of Niagara Falls, N. Y., will establish a branch factory in Lockport, N. Y.

The Northwestern Cabinet Company, Burlington, Iowa, will erect a $50,000 addition to be equipped with the latest machinery.

The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn., is having plans prepared for two new machine shops.

Fire destroyed the plant of the Creamery Package Manufacturing Company, Chicago, Ill., makers of ice machinery. Loss $40,000.

The Columbia Sash, Door and Lumber Company, Spokane, Wash., a new concern, has secured a permit for the erection of a plant.

The Ashcroft Manufacturing Company, maker of steam valves, etc., will build a four-story addition to its plant in Bridgeport, Conn.

The Boylston Manufacturing Company, Boston, Mass., will erect a plant in Fairhaven, Mass., for the manufacture of its shoe machinery.

An addition is being built to the plant of the Wells Bros. Company, Greenfield, Mass., manufacturers of screw-cutting tools and machinery.

The Louisa (Va.) Manufacturing Company is erecting a new plant and expects to install additional machinery for all kinds of woodworking.

The Cumberland (Wis.) Cement Works has been formed to manufacture cement building blocks. Peter Stoll and Allie Martell, organizers.

The Julian & Kokenge Company, Cincinnati, Ohio, shoe manufacturers, will erect an eight-story factory building, expending about $200,000.

The Sefton Manufacturing Company, Chicago, Ill., making folding paper boxes, will erect a new factory at a cost of nearly $250,000.

The Dennison Manufacturing Company, South Framingham, Mass., tags, etc., is erecting another five-story building, to cost $100,000.

The Utah Smelting Company, a new concern of Ogden, Utah, will erect a $1,000,000 smelting plant. David Eccles, of Ogden, is president.

The Robinson-McGill Manufacturing Company, Shelbyville, Tenn., is planning to erect a factory for the manufacture of carriages, buggies, etc.

The Providence (R. I.) Spark Coil Company has been incorporated with a capital of $50,000. H. C. Mills, of New Bedford, Mass., is president.

The Bessemer Contracting and Ballast Company, a new concern in McKeesport, Pa., capitalized at $150,000, will erect a $40,000 crushing plant.

The Centaur Iron Works, Des Moines, Iowa, has been recently reorganized and will erect a new plant for the manufacture of fire escapes, standpipes, etc.

The Southern Manufacturing Company is being organized in Jacksonville, Fla., to manufacture automobiles. H. E. Partridge is one of the promoters.

Fire caused a damage of $10,000 in the plant of the Bradley & Hubbard Manufacturing Company, Meriden, Conn., makers of gas fixtures, bronze goods, etc.

J. J. Kime, of Kendallville, Ind., will establish a plant in Shawnee, Okla., for the manufacture of heavy steel and a coil-spring fan, of which he is the inventor.

The Tennessee Stave and Box Company has been incorporated at Memphis, Tenn. Capital $200,000. A. H. Kersting, E. J. Hastings, etc., incorporators.

The Mitchell Safe Company, Minneapolis, Minn., a new concern with a capital of $250,000, has purchase da site for a new plant. Charles Mitchell is president.

The American Smelting and Refining Company, with headquarters at New York, will rebuild its Colorado plant, recently desttroyed by fire, at a cost of nearly $500,000.

The Southern Pacific Railroad has prepared plans for shop improvements at Sacramento, Cal. These will include a new blacksmith shop, erecting shop, boiler shop, etc.

The Manross Hair Spring Company, Forestville, Conn., is erecting a new factory, and in addition to a new gas engine a complete electrical plant will be installed.

The Gilbert & Bennett Company, Georgetown, Conn., manufacturing wire goods, is planning to build an addition to be used as a galvanizing and annealing department.

The Griffin Wheel Company, St. Paul, Minn., will probably in the near future build an addition to its foundry, at a cost of $10,000, and $15,000 more for equipment.

H. J. Wessinger, chief mechanical engineer of the Oliver Iron Mining Company, Duluth, Minn., will erect a plant for the manufacture of mechanical appliances, which he has invented.

F. Blumenthal & Co., morocco manufacturers, Wilmington, Del., have just completed a large addition, at an expense of about $170,000, and will soon begin another on the same scale.

The Seaboard Bridge and Structural Steel Works, Jersey City, N. J., recently incorporated, is making plans to build a large factory. Robert Giles, 5 East Forty-second street, New York, is one of the organizers.

J. M. Howard, Frank Howard and other capitalists of Pittsburg, Pa., owners of the Dorcas Mill in Florence, Colo., recently destroyed by fire, have decided to rebuild on a larger scale, entailing an outlay of nearly $300,000.

The Royal Typewriter Company, a newly organized concern with offices at 253 Broadway, New York, is equipping its large factory in Brooklyn with the latest and most improved machinery. This company is heavily capitalized. E. B. Hess and Nelson A. Miller are interested.

The Casey & Hedges Manufacturing Company and the Chattanooga Pipe and Foundry Company have consolidated under the name of the Casey-Hedges Company and will make big improvements at the plant in Chattanoogn, Tenn., expending about $150,000. These will include new pattern and machine shops, engine and boiler building, etc.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—To complete volume, AMERICAN MACHINIST of April 13, 1905. Will pay premium. Box 613, AMERICAN MACHINIST.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Established Canadian company wants metal articles in screws, stampings and machine parts to manufacture. "Specialties," Box 611, AMERICAN MACHINIST.

Wanted—Second-hand planer 48" wide by 10' long, screw feed; prefer one rigged for grinding. American Brake Shoe and Foundry Co., 405 Western Union Building, Chicago.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Shop Organizer — Little defects in tools, product and shop organization consume profits. For a moderate outlay I will visit your factory and reduce your manufacturing cost to the minimum. Thirty years' experience. C. E. Tower, 1237 Monadnock Block, Chicago.

Wanted — Mechanical superintendent for plant manufacturing hardware specialties and to have charge of small foundry. Require experience in fine bench work and core work. Write, stating experience. Salary $1500 to $1800. C 5809, The Engineering Agency, Inc., Chicago.

Trained men are in constant demand at high salaries. Our seven weeks' course fits you to drive, maintain and repair all gasolene cars. Day and evening classes. Inspection of building solicited. New York School of Automobile Engineers, 146 West Fifty-sixth street, New York.

Wanted to Purchase—Cleveland automatic screw machines with plain plungers and full Cleveland automatics; also 2-inch hollow spindle capstan lathes and larger. State full particulars regarding the condition of the machines and lowest price for same to the Auto Machinery Company, Ltd., Coventry, England.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

For Sale.

For Sale—Foundry, wood and iron machine shops, Albion, N. Y., Box 74.

Surface gauge (patent No. 495,365), novel and practical, cheap. P. Renko, 427 Rebecca avenue, Wilkinsburg, Pa.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AMERICAN MACHINIST.

For Sale—Second-hand 20x24 Atlas engine, heavy duty, automatic type, right hand with 9'x26" band wheel, speed 160 r.p.m. In good condition. Address Box 1, Columbus, Ohio.

Business Opportunities.

To arrange with party interested to furnish capital to build model of a typewriter adding machine; design completed. Box 620, AMERICAN MACHINIST.

A good opportunity for someone to buy a machine shop and foundry for only $3000, located in Central Missouri. J. W. Fischer, Fayette, Missouri.

Wanted—A manufacturer to build machines in the printing line in lots from six to twelve. State full particulars, location, etc. Box 546, AMERICAN MACHINIST.

Wanted—To correspond with capitalist, shop-owner or promoter interested in four-cycle type internal combustion motor; new invention for same; patent allowed. Address Practical, Box 629, AMERICAN MACHINIST.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nohing else.

ILLINOIS.

First-class machinist and toolmaker, 13 years' experience, wishes to change; would take position as foreman with concern doing light and accurate work; good designer of tools, jigs and fixtures; knows how to handle men. Box 619, AMERICAN MACHINIST.

INDIANA.

Position as superintendent; large experience handling work and men. Good executive; clever designer of short cuts and special tools. Fine record with past and present employers, all of whom can be offered as references. Changing for promotion. Prefers to figure on particularly hard propositions. Box 615, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman wishes position. Box 626, AMERICAN MACHINIST.

Mechanical engineer and designer wants change; responsible position. Box 624, AM. M.

Experienced draftsman wishes to make change. Apply, giving full particulars, to Box 622, AMERICAN MACHINIST.

Engineer desires change; where now employed has charge of drafting room, shops, power plant, construction and maintenance and purchasing department; thorough practical training in all branches. Box 580, AM. M.

NEW YORK.

Responsible position in steam turbine manufacture; several years' experience. Box 631, AMERICAN MACHINIST.

Master mechanic, designer, competent to build, improve special automatic machinery, reliable estimator. Box 633, AMER. MACH.

Practical machinist, experienced shop and garage man, open for foremanship or care of private garage; A-1 reference, character and ability. Box 630, AMERICAN MACHINIST.

Expert machine-tool operator, faculty for teaching those less experienced, including apprentices, wishes engagement, New York City or vicinity. Box 621, AMERICAN MACHINIST.

Chief draftsman desires change; energetic and executive; capable designer of machinery and mill construction; experienced in directing shop work. R. W., Box 604, AM. M.

Marine shop or dry dock superintending and consulting engineer with good connections would take interest and build up business. Address Enterprise, 592, AMER. MACH.

Superintendent of large concern desires correspondence from parties wishing a thorough up-to-date mechanic and business manager; large concerns preferred; any locality. Box 628, AMERICAN MACHINIST.

Successful engineer, machinist and draftsman, experienced modern industrial equipments, power plants, power transmissions and manufacturing machinery, is open to engagement. Box 632, AMERICAN MACHINIST.

Mechanical engineer, thoroughly experienced in designing and estimating for high duty pumping engines, electric light and power engines and marine work, desires position as chief engineer or superintendent. Box 623, AMERICAN MACHINIST.

Mechanical engineer or chief draftsman; practical experience on power printing machinery, gas, gasolene and kerosene-oil engines, hydraulic and mining machinery; familiar with modern shop methods. Address Box 590, AMERICAN MACHINIST.

A business woman of experience wants a position as advertising manager of a manufacturing concern in Eastern territory. Has had charge in two large concerns and refers to both. Capable of writing all ads, booklets, catalogs, etc.; familiar with all details of printing and illustrating. Box 542, AM. M.

Designer of automatic special machines, dies, jigs and fixtures with up-to-date improvements, desires position where mechanical ability is appreciated; with many years' experience on cash registers, adding machines, etc., would like to continue on same class of machines. Receiving $35 in present position. Box 602, AMERICAN MACHINIST.

Machinist—Worked three years at trade; am 23 years old and have been in a reformatory for a year; unable to work as a journeyman, but will go to work as an advanced apprentice. Want some humane employer to give me just one chance to show him what I can and will do to re-establish myself as a mechanic and a man. Box 614, AMER. MACH.

OHIO.

Mechanical engineer, 37, thorough, practical experience in shops and drafting room, technical, executive ability and commercial training, desires correspondence with firms having prospective openings. Box 522, AM. M.

PENNSYLVANIA.

Draftsman, mechanical, 27, varied experience machine details, mill work, jigs, fixtures, construction work; accurate. Energetic, 605, AMERICAN MACHINIST.

Foreman pattern-maker, 14 years' experience, would like to make a change. Six years with present firm; young man, sober, and with family. Box 603, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Competent toolmakers for gage and fixture work. Write fully as regards experience and wages expected. Apply Ross Rifle Company, Quebec, Canada.

Mouldmaker — One thoroughly familiar with work required for rubber factory; must be able to make his own tools and jigs. Write, stating experience and wages expected, to Mr. Whyte, P.O. Box 2267, Montreal, Canada.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Machinists—We have positions for good floor and bench hands. Steady work and good wages. Printing-press work. Address The Brown Cotton Gin Co., New London, Conn.

We are now located in our new buildings, with an up-to-date equipment, and solicit applications from first-class toolmakers, diemakers and machinists for high-grade work. Apply, stating age and experience, to The Yale & Towne Mfg. Co., Stamford, Conn.

Wanted—Thoroughly competent tool and diemaker capable of designing and constructing small tools, dies and jigs necessary for the production of small electrical specialties. To an ingenious and earnest worker an excellent opportunity is offered for advancement at good compensation. Address, stating full particulars, Box 24, Hartford, Conn.

ILLINOIS.

Wanted, draftsmen — We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to Western Electric Company, Dept. No. 29, Chicago.

LOUISIANA.

Wanted—First-class machine-tool salesman, who also has some knowledge of pumps and engines, to travel in the Southwestern territory, with headquarters at New Orleans. Box 607, AMERICAN MACHINIST.

MASSACHUSETTS.

Architectural draftsmen wanted who are familiar with mill construction. Vicinity of Boston. State age, experience and salary expected. Box 579, AMERICAN MACHINIST.

Wanted—Good mechanical draftsmen for designing electrical and steam apparatus; also

a few good detail draftsmen. Positions offer good prospects for advancement and are to be considered permanent for the right men. Send detailed statement as to age, education, experience and initial salary to Engineer in charge, Drawing Office, General Electric Co., West Lynn, Mass.

MICHIGAN.

Turret-lathe operator wanted for 21-inch American turret lathe; steady employment to man who can rush out the work. Northern Engineering Works, Detroit, Michr.

Wanted—Machinists and experienced toolmakers. Detroit is growing rapidly as an industrial center, and is one of the finest cities in this country. There is a scarcity of good machinists who are accustomed to all-around accurate work by modern up-to-date methods. Competent men who are experienced and will "do things right" can secure permanent employment at first-class wages. State age, experience, references, wages, and give full information. Cadillac Motor Car Co., Detroit, Mich.

MINNESOTA.

Wanted—First-class machinists, moulders and pattern-makers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel & Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Foundry foreman wanted in open shop. Give reference, experience, and state salary expected. Box 583, AMERICAN MACHINIST.

Wanted—Foreman with experience in erecting high-speed automatic engines. Reply, stating experience and pay expected. Box 587, AMERICAN MACHINIST.

Wanted—First-class mechanical draftsmen for a large concern in the vicinity of New York City. Give age, experience, reference and salary expected. Box 577, AMER. MACH.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Mechanical draftsman with experience on small automatic and semi-automatic machinery. Steady and good position for the right man. Give experience and salary expected. P. W. C., Box 625, AMERICAN MACHINIST.

Wanted—A first-class designer on tools for production of interchangeable parts of small and medium size machinery. Must be capable of looking after several other draftsmen. State age, experience, references, and salary expected. Address reply to Box 547, AM. M.

NEW YORK.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

First-class mechanical draftsmen desired; state age, experience and salary expected. Box 507, AMERICAN MACHINIST.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Mechanical draftsman, one with technical training and practical experience in detail work. State age, experience and salary. Location, New York City. Box 612, AM. MACH.

Machinist—For floor work. Permanent employment for good men. Wages $2.50 per day; 9 hours work day; time and a half for overtime, double time for holidays. Location 25 miles from New York City. Box 268, AMERICAN MACHINIST.

Wanted—First-class mechanical engineer as purchasing agent; only one having experience in purchasing need apply. State full particulars as to references, salary, etc. Eastern or Pennsylvania men preferred. Address X Y Z, Box 617, AMERICAN MACHINIST.

We are permanently increasing our capacity and require the services of 20 mechanical draftsmen for detail work. Attractive positions to suitable men. Location in New York City. Address, stating age, experience and salary expected, Box 627, AMER. MACHINIST.

Wanted—Machinist with road experience as salesman, calling on all iron-working plants. Knowledge of turrets, automatics and threading machines, cutting tools and dies essential. State age, experience, salary expected and references. Box 618, AM. MACH.

Wanted—Young man, experienced mechanic and manager of men and work, as department foreman; light and medium duplicate work. Permanent, with opportunities for advancement. State in detail past experience, length time each position, age, salary wanted to start with. Manufacturer, Box 974, Buffalo, N. Y.

OHIO.

Wanted—A first-class, competent foundry foreman. Box 610, AMERICAN MACHINIST.

Wanted—Experienced foreman for screw department of manufacturing concern. Box 575, AMERICAN MACHINIST.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 609, AMERICAN MACHINIST.

Foreman wanted for a machine shop operating small and medium-size tools. State age, experience and salary. Box 595, AM. MACH.

Wanted—A first-class machine draftsman for automobile work, one who has had considerable experience in this class of work desired. Address "Machine Draftsman," Box 538, AMERICAN MACHINIST.

Wanted—First-class gas-engine designer, one having experience in designing four-cylinder automobile engines, by one of the largest automobile manufacturers in this country. Address "Engine Man," AMERICAN MACHINIST.

The National Metal Trades Association can place a few first-class wood pattern-makers, tool-makers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, O.

Wanted—A capable foreman for a forge; one thoroughly familiar with steam hammers, general forge work, tempering, etc. Factory located in one of northern Ohio's largest cities. Give age, references, experience and salary expected. Box 608, AMER MACHINIST.

Tool-makers, experienced on compound punch and die work. Boring-mill operators, experienced on close work on large vertical boring mills. No trouble. Best of rates to A-1 men. Apply to The Bullock Electric Mfg. Co., East Norwood, Cincinnati, O.

PENNSYLVANIA.

Draftsman wanted—Young man, must have experience on tool work. Give references. Box 616, AMERICAN MACHINIST.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 578, AMERICAN MACHINIST.

Wanted—Fifty first-class toolmakers or machinists; good wages to right parties; no labor troubles. Driggs-Seabury Ordnance Corporation, Sharon, Pa.

Wanted—Ten lathe hands for night turn, also pattern-maker, day time. Write, giving experience and wages expected. Wilson Laundry Machine Company, Columbia, Pa.

Wanted—Experienced machinist, capable of taking charge as foreman of shop on valves and fittings. In reply state age, where employed at present, and experience in detail. Good opportunity for the right man. Box 573, AMERICAN MACHINIST.

Wanted—A few first-class machinists and tool-makers; also one or two automatic screw-machine operators, for automobile work; steady work guaranteed. Address, giving experience, references and wages desired, The Autocar Company, Ardmore, Pa.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: character, common sense, experience with automatic machinery (or) printing office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more pattern makers, machinists and moulders.

Unusual opportunity for a man with mechanical ability to work into a position of responsibility. Must be energetic, tactful and a good executive, capable of handling men, and a good machinist. Plant located in Wisconsin. Reply, giving full experience, present occupation, and salary desired. Box 509, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—A first-class foreman for plant manufacturing gasolene engines and air compressors. Good opening to a man of executive ability. State age, experience, reference and salary expected. Box 597, AM. MACHINIST.

Wanted — Good mechanical draftsman, one familiar with machine design, gasolene engines and air compressors preferred. State age, experience, references and salary expected. All communications confidential. Box 606, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	102
Acme Machinery Co.	34
Adams Co.	9
Albro-Clem Elevator Co.	96
Alliance Machine Co.	92
Allington & Curtis Mfg. Co.	80
Almond Mfg. Co., T. R.	105
Alteneder & Sons, Theo.	34
American Gas Furnace Co.	14
American Pulley Co.	101
American Tool & Machine Co.	105
American Tool Works Co.	8
American Tube & Stamping Co.	107
Armstrong Bros. Tool Co.	81 & 95
Auburn Ball Bearing Co.	85
Automatic Machine Co.	86
Baker Bros.	26
Baird Machinery Co.	83
Baldwin Chain & Mfg. Co.	84
Baldwin Steel Co.	79
Barnes Co., B. F.	110
Barnes Co., W. F. & John.	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E.	100
Bay State Stamping Co.	91
Bay State Tap & Die Co.	102
Bay State Tool Co.	26
Beaman & Smith Co.	15 and 104
Becker-Brainard Milling Machine Co.	23
Bell Electric & Mfg. Co.	26
Bell Engineering Wks., David.	83
Bertram & Sons Co., John.	26
Besly & Co., Chas. H.	103
Bethlehem Fdry. & Mach. Co.	85
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	84
Bilgram, Hugo.	34
Billings & Spencer Co.	89
Binsse Mach. Co.	34
Birdsboro Steel Fdry. & Mach. Co.	71
Blaisdell Machinery Co.	106
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	100
Boker & Co., Hermann.	77
Boston Gear Works.	98
Boynton & Plummer.	88
Bowers, E. J.	26
Bradford Machine Tool Co.	5
Bridgeport Safety Emery Co.	102
Bristol Co.	4th cover
Brown-Cochran Co.	90
Brown & Co., R. H.	104
Brown Hoisting Machine Co.	95
Brown & Sharpe Manufacturing Co.	4th cover and 67
Brubaker & Bros., W. L.	96
Buffalo Forge Co.	4th cover & 77
Builders Iron Fdry.	3d cover
Bullard Machine Tool Co.	32
Bury Compressor Co.	106
Butler, A. G.	92
Calculagraph Co.	94
Caldwell & Son Co., H. W.	99
Carborundum Co.	24
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	96
Case Mfg. Co.	92
C & C Electric Co.	27
Chambersburg Eng. Co.	85
Champion Tool Works Co.	86
Chandler & Farquhar Co.	84
Chattanooga Machinery Co.	96
Chicago Rawhide Mfg. Co.	98
Chisholm & Moore Mfg. Co.	92
Cincinnati Electrical Tool Co.	102
Cincinnati Machine Tool Co.	25
Cincinnati Milling Mach. Co.	6 and 7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	110
Clark Cast Steel Cement Co.	108
Clark, Jr., & Co., Jas.	90
Cleveland Automatic Mach. Co.	18
Cleveland Crane & Car Co.	92
Cleveland Twist Drill Co.,	4th cover
Cleveland Wire Spring Co.	89
Clough, R. M.	81
Coates Clipper Mfg. Co.	94
Coes Wrench Co.	33
Colburn Machine Tool Co.	24
Columbus Machine Co.	90
Cook Co., Asa S.	106
Crescent Forgings Co.	101
Cresson Co., Geo. V.	95
Crocker-Wheeler Co.	28
Crosby Steam Gage & Valve Mfg. Co.	17
Cumberland Steel Co.	108
Curtis, A. B.	86
Curtis & Co. Mfg. Co.	86

	PAGE
Curtis & Curtis Co	108
Cushman Chuck Co	104
Davis, Rodney	98
Davis Machine Co., W. P	82
Detrick & Harvey Mfg. Co	90
Diamond Machine Co....3d cover	
Diehl Mfg Co	26
Dill Machine Works, T. C., 26 and	82
Dixon Crucible Co., Joseph	91
Dodge & Day	90
Dreses Machine Tool Co	80
Durbrow & Hearne Mfg. Co	106
Dwight Slate Machine Co	96
Earle Gear & Mach. Co	99
Eberhardt Bros. Mach Co	91
Eck Dynamo & Motor Works	26
Elliott Chemical Works	91
Elmes Eng. Works, Chas. F	106
Elmira Machine Works	88
Equipoise Rivet Co	87
Errington, F. A	105
Evans Friction Cone Co	90
Excelsior Needle Co	108
Fairbanks Co	83
Farrel Fdry. & Mach. Co	108
Fawcus Machine Co	96
Fellows Gear Shaper Co	98
Fenn-Sadler Machine Co	86
Firth-Sterling Steel Co	109
Fitchburg Machine Works	31
Foos Gas Engine Co	90
Fosdick Machine Tool Co	16
Franklin Mfg. Co. H. H	97
Frevert Mach. Co	92
Gang, Wm. E	85
Gardner Engineering Co	102
Gardner Machine Co	102
General Electric Co	28
General Pneumatic Tool Co	93
Geometric Tool Co	25
Gilmore Electric Co	31
Gleason Works....4th cover	
Goldschmidt Thermit Co	108
Goodell-Pratt Co	84
Gorton Machine Co., Geo	102
Gould & Eberhardt	96
Graham Mfg. Co	90
Grant Gear Works	98
Gray Co., G. A	34
Gray & Prior Machine Co	95
Greaves, Klusman & Co	83
Greendale Gas Engine Co	90
Greenwald Co., I. & E	99
Hammacher, Schlemmer & Co.	73
Hampden Corundum Wheel Co	103
Harrington, Son & Co., Edw	93
Hendey Machine Co	75
Henley Publishing Co., N. W	81
Henry & Wright Mfg. Co	93
Heppenstall Forge & Knife Co.	102
Hess-Bright Mfg. Co	91
Hill, Clarke & Co	83
Hisey-Wolf Machine Co	91
Hoefer Mfg. Co	26
Holbrook Mfg. Co	88
Horsburgh & Scott Co...4th cover	
Horton & Son Co., E	104
Hunt Co., C. W	92
Hunt & Co., Robt. W	88
Hyatt Roller Bearing Co	92
Ingersoll Milling Machine Co.	94
Ingersoll-Rand Co	107
International High-Speed Steel Co	108
Iroquois Machine Co	103
Jacobs Mfg. Co	104
Jacobson Mach. Mfg. Co	90
Jantz & Leist Electric Co	26
Jeffrey Mfg. Co., The	82
Jenkins Brothers	91
Johnson Mach. Co., Carlyle	100
Jones & Co., B. M	108
Jones & Lamson Mach. Co., 12, 13 and	34
Kempsmith Mfg. Co	22
Kent & Co., Edwin R	108
Kilbourne & Jacobs Mfg. Co	87
King Machine Tool Co	96
Landis Machine Co	81
Landis Tool Co	69
Lapointe Machine Tool Co	85
Le Blond Machine Tool Co., R. K....4th cover and	20
Le Count, Wm. G	104
Link-Belt Engineering Co	80
Lodge & Shipley Machine Tool Co	4
Long & Allstatter Co., The	87
Lumen Bearing Co	109
Lunkenheimer Co., The	91
Lyon Metallic Mfg. Co	20
Main Belting Co	100
Maris Brothers	92
Marshall & Huschart Mach. Co....83 and	84
Massachusetts Saw Works	88
McCabe, J. J....82 and	105
McGeorge Mfg. Co	88
McInnes Steel Co	108
Merrell Mfg. Co	86
Merrill Bros	90
Merritt & Co	85
Mfg. Equipment & Eng. Co	105
Michigan College of Mines	104
Mietz, A	90
Millers Falls Co	88
Miner & Peck Mfg. Co	87
Modern Machinery Daily News	96
Moore & Co., Franklin	92
Morris Foundry Co., John B.	15
Morse Chain Co	84
Morse Twist Drill & Machine Co	33
Morse, Williams & Co	99
Motch & Merryweather Machine Co	83
Mueller Machine Tool Co	81
Mutual Machine Co	26
National Acme Mfg. Co	110
National Brake & Clutch Co	79
New Britain Machine Co	106
New Era Gas Engine Co	90
New Haven Mfg. Co	81
New Machine Co	108
New Process Rawhide Co	99
New York Telephone Co	86
Newton Machine Tool Works	11
Nicholson File Co	17
Nicholson & Co., W. H	106
Niles-Bement-Pond Company, 82, 111, 112, 113,	114
Northern Electrical Mfg. Co	29
Northern Engineering Works	92
Norton Emery Wheel Co	71
Norton Grinding Co	30
Nuttall Co., R. D	98
Nutter, Barnes & Co	88
Obermayer Co., S	87
O. K. Tool Holder Co	83
Omega Steel & Tool Co	108
Owen Machine Tool Co	22
Parker Co., Charles	90
Patterson, Gottfried & Hunter, Ltd	100
Pawling & Harnischfeger	92
Paxson Co., J. W	98
Philadelphia Bourse	86
Philadelphia Gear Works	98
Phillips-Lafitte Co	92
Poole Co., J. Morton	94
Potter & Johnston Mach. Co	75
Pratt Chuck Co	104
Pratt & Whitney Co....2 and	3
Prentiss Tool & Supply Co	82
Queen & Co	88
Ransom Mfg. Co	101
Reed Mfg. Co	90
Reeves Pulley Co	24
Reichheim & Co., E. P...4th cover	
Rivett-Dock Company....3d cover	
Rivett Lathe Mfg. Co....3d cover	
Rockford Machine Tool Co	88
Rockwood Mfg. Co	85
Rogers Works, John M	86
Rowbottom Machine Co	102
Safety Emery Wheel Co	102
Sames, C. M	88
Saunders Sons, D	91
Sawyer Gear Works	98
Schieren & Co., Chas. A	81
Schumacher & Boye	9
Schwerdte Stamp Co	86
Scranton & Co	98
Sebastian Lathe Co	85
Sellers & Co., Wm	21
Seneca Falls Mfg. Co	94
Shelby Steel Tube Co	108
Shultz Belting Co	81
Sibley Machine Tool Co	94
Simonds Mfg. Co	96
Skinner Chuck Co	104
Sloan & Chace Mfg. Co	34
Slocomb Co., J. T	14
Smith & Mills	87
Soltmann, E. G	88
Spacke Machine Co., F. W	106
Speed Changing Pulley Co	87
Spicer Universal Joint Mfg. Co	84
Sprague Electric Co	28
Springfield Machine Tool Co	103
Standard Engineering Works	87
Standard Gauge Steel Co	99
Standard Machinery Co	96
Standard Tool Co	89
Stanley-G. I. Elec. Mfg. Co	1
Stark Tool Co	104
Starrett Co., L. S	16
Steptoe Shaper Co., John	85
Stevens, F. B	87
Stoever Foundry & Mfg. Co	91
Struthers-Wells Co	90
Sturtevant Co., B. F	27
Switchboard Equipment Co	27
Taylor-Wilson Mfg. Co	98
Three Rivers Tool Co	104
Toomey, Frank	81
Triumph Electric Co	26
Trump Bros. Machine Co	104
Turner Brass Works	88
Underwood & Co., H. B	106
Union Twist Drill Co	73
United Eng. & Fdry. Co	109
U. S. Watch Tool Co	81
VanDorn & Dutton Co	98
Van Dyck Churchill Co	30
Veeder Mfg. Co	87
Vitrified Wheel Co	102
Wallace Supply Co	106
Waltham Machine Works	90
Waltham Watch Tool Co	97
Ward & Sons, Edgar T., 33 and	108
Warner, C. S	95
Warner Instrument Co	82
Warner & Swasey Co	69
Waterbury Farrel Foundry & Machine Co	106
Watson-Stillman Co	105
Webster & Perks Tool Co	102
West Haven Manufacturing Co....4th cover	
Westinghouse Elec. & Mfg. Co.	29
Westmacott Co., J. M	104
Whitcomb-Blaisdell Machine Tool Co	19
Whitman & Barnes Mfg. Co	103
Whitney Mfg. Co	65
Whiton Mach. Co., D. E	104
Wiley & Russell Mfg. Co	84
Wiley & Sons, John	34
Wilmarth & Morman Co	91
Windsor Machine Co	87
Wood's Sons, T. B	87
Woodward & Powell Planer Co.	96
Worcester Mach. Screw Co	108
Wormer Mach. Co., C. C	84
Wyman & Gordon Co...4th cover	
Yale & Towne Mfg. Co	95

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alloy, Nickel

Boker & Co., Hermann, N. Y.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects

Dodge & Day, Philadelphia, Pa.

Ball Bearings

See Roller Bearings

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Kilbourne & Jacobs Mfg. Co., Columbus, Ohio.
Lyon Metallic Mfg. Co., Chicago, Ill.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Eng. Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Bars, Boring Cylinder

Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Cling-Surface Co., Buffalo, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting Leather

Main Belting Co., Phila., Pa.

Belting Leather—*Continued*

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chains

See Hoists Hand.

Blowers

Am. Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co Springfield, O.

Bolt and Nut Machinery *Continued.*
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New Yr.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co. Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brazing Plates
Phillips-Lafitte Co., Phila., Pa.

Broker, Machinery
Warner, C. S., Niagara Falls, Ont.

Bulldozers
Prentiss Tool & Supply Co., New York.

Burners, Oil
Tate, Jones & Co., Pittsburg, Pa.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Chucks, Drill—*Continued*
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co. Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co, D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
American Tool & Machine Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Double Friction Coil Clutch Co., Chicago, Ill.
Johnston Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., N. Y.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compounds, Pipe Joint
Dixon Crucible Co., Jos., Jersey, City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.

CHAIN DEPARTMENT

Roller Chains Block Chains
"Wizard" Chains.

MACHINE DEPARTMENT

Hand and Weight (feed) Milling Machines,
20-inch Water Tool Grinders.

MISCELLANEOUS DEPARTMENT.

Keys and Cutters for the Woodruff Patent System of Keying
"Presto" Chucks, Collets and Friction Tapping Devices
Sprockets for "Wizard" Chains
Hartford Printer.

"Presto" Chucks, Collets and Friction Tapping Devices are used in Drill Presses, Turret Machines and Lathes and they make possible the rapid change of Drills, Reamers, Counterbores, Taps, etc., without stopping the spindle of the machine.

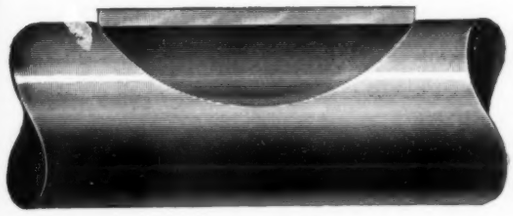
Patented

Detachable Type

Patented

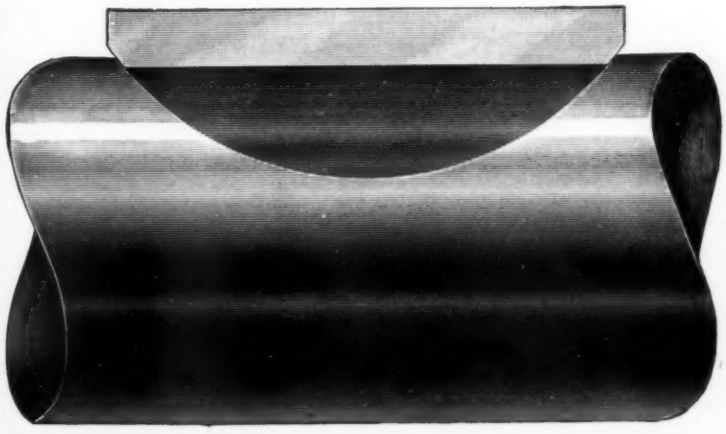
Against claims made by Competitors, we submit the following list of Motor Car Manufacturers using "WHITNEY" ROLLER CHAINS and STANDARDS. Is it not time for everyone to admit that "WHITNEY" STANDARDS for ROLLER CHAIN dimensions are now the American Standards?

"ADAMS-FARWELL" "AMERICAN MOTOR TRUCK" "AUTO-CAR EQUIPMENT" "BAKER" "BERKSHIRE" "BIDDLE-MURRAY" "CADILLAC" "COLUMBIA" "CHAMPION (McCrea)" "CROWN" "CRAWFORD" "COLUMBUS BUGGY CO." "ELWELL-PARKER" "FORD" "FRANKLIN" "GAETH" "GALE" "GROUT" "HEWITT" "THE HOLMES" "IROQUOIS IRON WORKS" "LAMBERT" "KNOX" "MATHESON" "MACK BROTHERS" "MITCHELL" "MOLINE" "NEW YORK MOTOR TRUCK" "OLDS" "PACKARD" "RAMBLER" "RAPID" "REO" "STEARNS" "THOMAS" "TOURIST" "VECHICLE-EQUIPMENT" "WAYNE" "WESTERN MOTOR TRUCK" "WINDSOR" etc.



The "Woodruff" System is more mechanical, more efficient, and also a great Labor Saver.

The "WOODRUFF" Patent System of Keying



has been adopted by the Leading Manufacturers of Machinery, Automobiles, etc.

THE

WHITNEY MFG. CO.

Hartford, Conn., U. S. A.

Cranes—*Continued.*

Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable

Nicholls, Wm. S., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

Cut Meters

Warner Instrument Co., Beloit, Wis.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Obermayer Co., S., Cincinnati, O.
Queen & Co., Philadelphia, Pa.

Drawing Materials

Queen & Co., Philadelphia, Pa.
Soltmann, E. G., New York.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co. Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn-Sadler Mach Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass
Hisey-Wolf Mach Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.

Drilling Machines, Radial *Continued.*

Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin,, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, Ohio.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail

Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors

Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Dynamotors

Sprague Elec. Co., New York.

Elapsed Time Machines

Calculagraph Co., New York.

Electrical Supplies

Clark, Jr., & Co., James, Louisville, Ky.
D'Olier & Co., H., Phila., Pa.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., & Co., James, Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical

Dodge & Day, Philadelphia, Pa.
Thompson, Hugh L., Waterbury, Conn.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Philadelphia, Pa.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N.Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.

The Works of the L. S. Starrett Company at Athol, Mass.

Like most of the Athol manufacturing establishments, the Starrett shops are located on Miller's river and for the greater part of the time are operated mainly by water power, a steam engine being held in reserve, however, for use during certain seasons of the year. The plant consists of three main buildings, two of which, the present office building and one of the shops, are three-story and basement structures of brick; while across the street is the oldest shop of the group, a frame building still operated to its full capacity. A subway under the road connects the two sections of the plant and permits the easy transfer of material from one shop to the other.

A view in the engine room of the new shop is presented in Fig. 1, showing the 350-h.p. cross compound, which is called into service when the turbine water wheel is out of commission because of low water, and to the left will be seen part of the apparatus for generating current for lighting and for operating a few motors located at various points about the shop.

As our readers know, this company confines itself entirely to the manufacture of small tools for mechanics, and over four hundred people are employed in this line in the different departments of the works. A few views in the work rooms of the new shop are shown in Figs. 2 to 4 inclusive; the remaining views illustrate various branches of work carried on in the old factory.

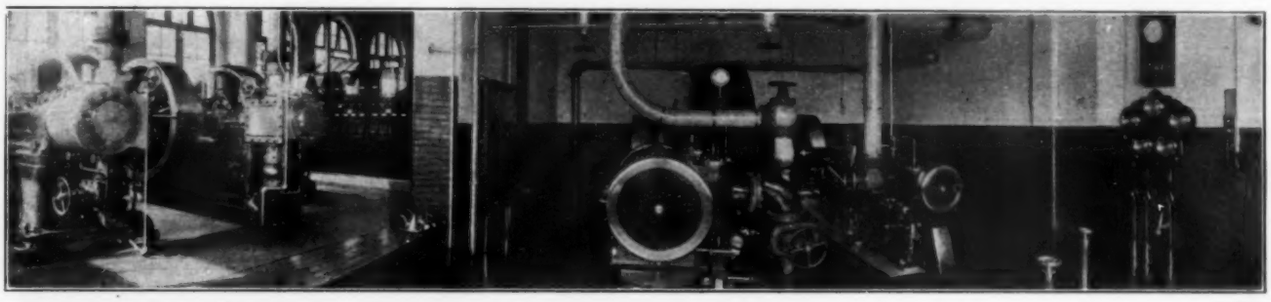


FIG. 1. ENGINE AND DYNAMO ROOM.

THE MICROMETER DEPARTMENT.

To the toolmaker or machinist visiting the Starrett shops probably the most interesting section of the plant is the department illustrated in Fig. 2, where may be seen thousands of micrometers of all sizes in various stages of manufacture as well as many completed instruments ready for removal to the packing room.

At one side of the department are a number of small lathes in which the micrometer screws are cut. These machines are of special design, and have a bed perhaps 30 inches in length, with a carriage mounted at the front instead of on top, the front face of the bed thus receiving the carriage in the same way that a planer rail receives the head. The feed screw is located near the middle of the bed, and the carriage nut is mounted in a lug extending through a slot formed in the bed. The work is steadied by a V-rest which bears against the back of the piece and a single-pointed tool cuts the thread. The tool slide admits of very nice adjustment for the cut, and the men who operate the lathes become very expert on this class of work, one man threading perhaps sixty micrometer spindles per day.

FIG. 2. MICROMETER DEPARTMENT.

On this floor, which is the upper one in the new building, is located also a department for assembling bevel protractors and various other instruments with which the shop man is familiar.

THE TOOL ROOM AND SOME OTHER DIVISIONS OF THE NEW SHOP.

The floor below is fitted up as a tool room, a view in which is presented in Fig. 3. There is a good deal of special machinery used about the plant and most of it is built in this room along with jigs and fixtures and shop tools generally, the maintenance of which of course keeps quite a force busy. Experimental work in connection with new devices is conducted in a well equipped room partitioned off from the tool room proper.

Upon descending to the next floor the visitor enters the packing and shipping room and also finds here the store room for finished parts which is enclosed by wire netting, and which contains an endless variety of accurately finished material ready for assembling. The store keeper issues the parts on order to the departments which do the assembling, and he maintains a record from which at any moment he can tell just what stock is on hand, and when to order in new parts from the shop.

The lower floor, to which one descends on his way to the subway leading to the other shop, is utilized mainly by the polishing department, Fig. 4, where such parts as calipers, dividers, etc., undergo buffing operations preliminary to being sent to the stock room. As will be noticed the polishing jacks in this room are all equipped with sheet-metal hoods, and an exhaust system carries away emery dust and particles of steel.

OPERATIONS CARRIED ON IN THE OLD SHOP.

Entering this shop via the underground passage, the first section visited is the bar and sheet stock room which has the usual complement of shears and cutting-off machines. Near by is a japanning room, and a little further along is the hardening department. The furnaces are arranged to use oil fuel and the workmen handle in

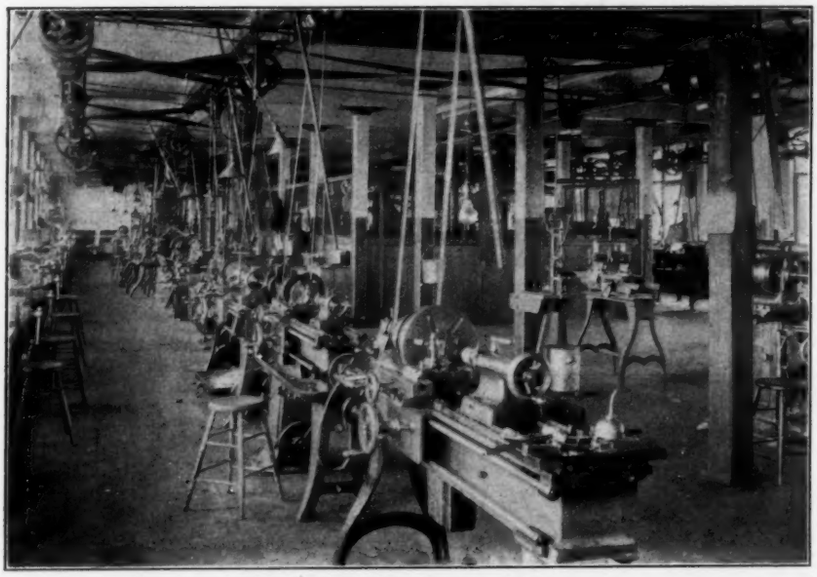


FIG. 3. TOOL ROOM.

the course of a day large quantities of small parts like micrometer points, combination square blades, center punches and other tools requiring hardening and tempering. Such parts as the blades mentioned are straightened by resting on a steel block and striking with a hammer; to a large extent, however, warping is prevented by clamping the hot piece between special jaws while flooding with oil or other cooling medium.

A view in the screw-machine department, which occupies part of the main floor, and which contains fifty or more automatics of various makes, is given in Fig. 5, and the punch-press shop on the same floor is shown in Fig. 6.

MILLING.

Fig. 7 is a view in a milling department where level bodies, combination square heads, and a multitude of parts entering into tool construction are machined by the aid of special tools and fixtures. A type of miller fixture used quite commonly here for machining narrow parts, like the square heads noted, is arranged to receive two strings of castings which are clamped to either side of a central web, while the upper faces and both edges are finished by gang mills. Such a fixture will be noticed in place on the miller at the right-hand side of the photograph, and it will be seen that the vertical portion of the casting is provided with locating pockets to receive the work. Both sides of the fixture are alike, and the clamps at each side are tightened by turning the one nut.

One of the busiest rooms in the shop is that utilized by the caliper and hacksaw-frame departments, and still another interesting section is the one shown in Fig. 8 where screw-pitch gages are milled and speed indicators, surface gages and certain other appliances manufactured. This division of the works, like the rest of the

FIG. 4. POLISHING ROOM.

FIG. 5. SCREW MACHINE DEPARTMENT.

departments, is equipped with special tools and machines for facilitating milling, drilling and other operations.

THE LEVEL DEPARTMENT.

One section of this shop is devoted to the setting of vials in iron levels, combination square heads, protractor heads, etc., the operation consisting of slipping the vial into its seat, adjusting it properly and cementing it in place.

The glass is first well coated with the preparation and after it is placed in its pocket, the cementing mixture is forced under the end of the vial until the bubble comes central. The work during the operation rests on a perfectly level surface plate, or where plumb vials are being set, is held against a vertical straight-edge mounted at the corner of the surface plate.

In the case of adjustable bench levels the procedure is, of course, different, the vials coming to the assembling bench

already secured in their metal tubes and ready for adjustment to the iron bases.

Designing a Boring Mill.

BY ENTROPY.

After seeing the way L. C. L., at page 428, and Mr. DeLeeuw, at page 472, have hauled my article, Designing a Boring Mill, over the coals, I begin to feel with Oliver Wendell Holmes that I shall never again dare to write as funny as I can, but for an entirely opposite reason. In everyday life it is the bane of my existence that I cannot get people to take me seriously. If I tell a man that he is a blankety blank idiot, he goes along with a smile and wonders if I don't really mean to raise his pay, and if I order a carriage to go for a drive, the stableman telephones over to my wife to find out if we are really going. But now that two people have taken me seriously, I do not know that I feel any bet-

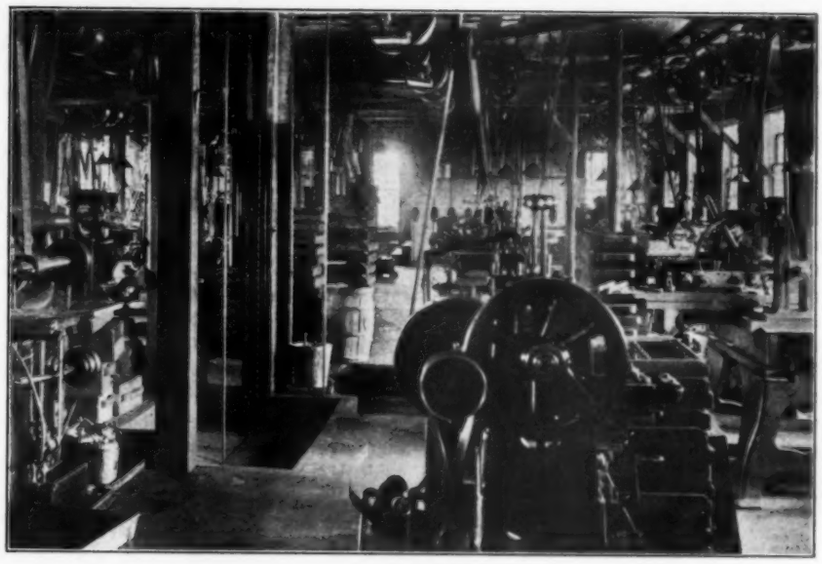


FIG. 7. MILLING DEPARTMENT.

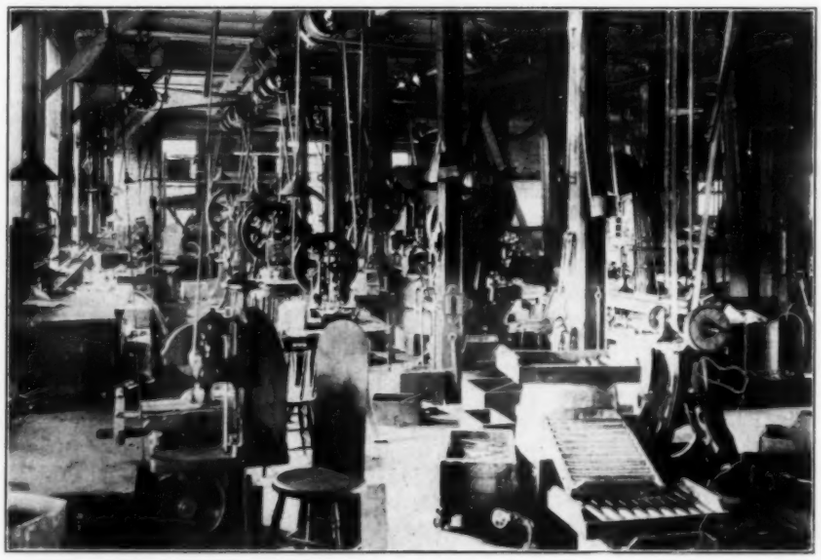


FIG. 6. PUNCH-PRESS ROOM.

ter about it. When L. C. L. said that there were glimmerings of sense to be seen, I was pleased, for every man likes to have people find sparks of sense in any of his sayings; but when by inference he limited the compliment to glimmerings, he touched a tender spot. And Mr. DeLeeuw; he has ferreted out that I am a planer hand, and I have earned my daily bread and butter over a planer; he has discovered that I dabble in carpenter work, and he also has discovered my fondness for mission furniture, and that I always judge of its probable appearance by a side view, all of which is true; but how he should guess that in my inmost soul I am debating whether to try to do a job of plastering I cannot imagine. And then to think that he should swallow my reasoning (?) whole without sorting it out. And he even failed to notice that the editor did not christen my article, "How to Design a Boring Mill," but only in a non-committal way, called it "Designing a Boring Mill." If he had only noticed this it would have saved him all that he wrote till he came to the word "further."

As to L. C. L.'s statement, I can well see that a college professor would not wish to see such an article pass unchallenged on account of its effect on his students. I realize only too well that it is almost impossible to keep work with students within the beaten track that can be covered by the use of text books, and in which precedent can be ignored in favor of strict computation from positive conditions to reasonably certain results. But that is not the trouble; not that these things are not reducible to usable form, but that so few of them have been. Machine-tool design is the worst possible subject for the technical colleges to handle, for it has been the least reduced to a solid basis of anything that I know of, and this in spite of the fact that practically every technical college in the land dabbles in machine tools to some

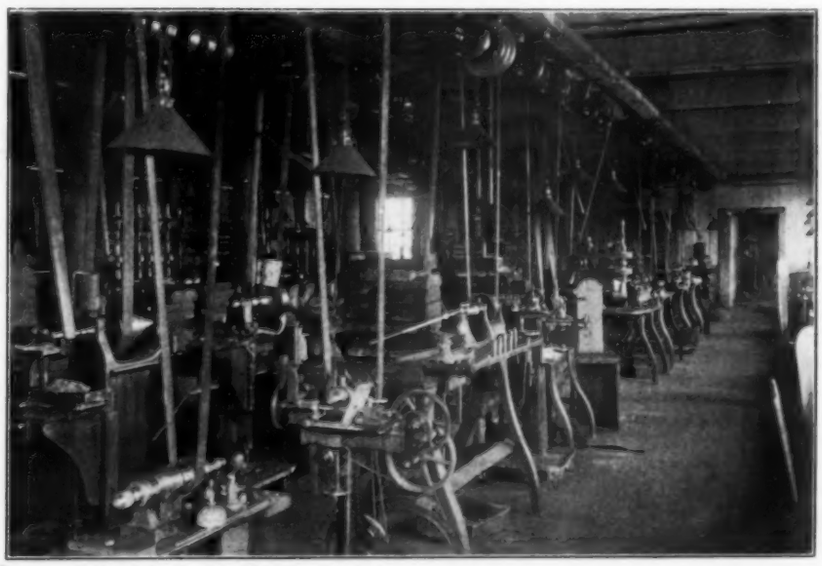


FIG. 8. ANOTHER MILLING DEPARTMENT.

extent. Even Lehigh, which appears to disdain a shop, has its students, according to its catalog, design some machine tool during their course. And in spite of all this, the colleges have contributed almost nothing to our fund of information.

We have various formulas for strenth of gear teeth, and the Manchester experiments (the results of which were used in my work and which Mr. DeLeeuw doubts) and various formulas for the strength of shafts, but of these most are shop born; and even of these the Lewis formula is discredited 25 per cent. by Mr. DeLeeuw and was discredited for similar work by a much greater per cent. in these columns a few months ago, while the results of the Manchester tests were discounted by a report from the University of Illinois in the same issue in which my original article appeared, and would, I believe, have been discounted still more if they had not blindly followed the lead of Professor Nicholson in grinding their tools. So we see that, so far as the books are concerned, there is little that we can feel to be stable enough to work from.

Suppose we ask a designer of lathes to tell us what size spindle to put in an ordinary 18-inch lathe. These range from 2¾ to 3⅜ inches in various lathes. The stresses liable to come upon them are easily to be found but will he sit down and compute them? No, he will name some size between 2¾ and 3⅜ inches and his size within those limits is as liable to depend on the direction of the wind or on how his breakfast is digesting as on any matter relating to stresses. But suppose his employer comes along and asks him why he does not make it bigger? He must have a reason that will sound plausible, just as the man who comes home at two o'clock in the morning must have a reasonable excuse. I do not want Mr. DeLeeuw to think that I suspect him of designing his boring mill first and then of getting at his reasons afterward, for I am only talking about the rank and file of draftsmen, not of the top notchers.

But even Mr. DeLeeuw's article cannot, it seems to me, be much more satisfactory to L. C. L. than mine. To be sure his reasoning in some cases sounds more plausible, but is it really any better as viewed from outside the ranks of boring-mill builders? And he knocks down much more than he builds up.

THE TABLE.

He says, for example that he objects to the reasoning by which I determined the diameter of my table. Well, if the boss should come around and ask me why I made the table 60 inches diameter, I probably would answer him about like this: The larger the diameter of the table the larger the gear, the less the pressure on the teeth, and the less the larger work will project over it. The smaller the diameter of the table the easier to get at boring bars and cutters when boring holes. To a man of average hight, 30 inches is a good fair reach. I know this from having run a planer with a table 60 inches wide and feel that more would be uncomfortable. More than that you have called for a high speed for small holes which will make the rim of this table travel pretty lively if I go much higher. In my judgment 60 inches will be about right. Sounds better, doesn't it? Is it any better? Is it any better for Mr. DeLeeuw to calmly say that boring mill tables *are* made certain sizes, hence mine should be? That is what I call copying pure and simple. It surely does not come out of any machine design book. Let us take Mr. DeLeeuw's article and see if we cannot analyze a point here and there too, since he offers his article in evident seriousness.

THE MAIN GEARS.

The Lewis formula was derived from tests of actual gears. The gear from which I made my inference was an actual gear which has been made a considerable number of times, has always been successful and is not so far from the size and capacity of the one which I wished that my inference was any worse than his inference from his own experience that the results of the Lewis formula could be raised 25 per cent. By comparison with the University of Illinois experiments it will be seen that my results will not come so far out of the way if treated by the Lewis formula. Was this the result of a sort of "horse sense" that told me more nearly what a given gear would do than the combined result of the Manchester experiments and the Lewis formula? Possibly. Mr. DeLeeuw prefers 16 or 17 teeth in the driving pinion; reason, it has worked better on other mills. Someone else may have used 18 or 19 for the same reason. What is his limit, and why? Did he get this out of a book?

I am not trying to defend my reasoning(?) but only to ask that it may stand till someone brings out reasons which will stand close inspection. I realize that Mr. DeLeeuw knows these things and that he is good authority, but he seems to criticize my reasoning rather more than my design, so I ask of him that he put his reasoning on a plane where we can look all around and under it and not suspect that it is attached to something that he does not show.

THICKNESS OF TABLE.

A plate of cast iron ½ inch thick would stand a cut 1/7 inch deep on its edges if as well supported as this table will be, so my allowance of an inch of metal ought to be enough to resist this stress. The weight which would tend to bend the table downward in the middle must all be placed within the annular bearing. The greatest weight that can be gotten on within that limit would not have an appreciable effect on a table an inch thick ribbed as this is. Because a builder of crane girders bellies them downward to gain strength and save hight, is no reason why I may not use an arch form when using cast iron. Even then the worst stresses that come on such a table are those imposed by the workman when he straps down work and they are bad mainly because they tend to distort the bearing of the table on the bed. The great depth of the gear makes this distortion improbable, hence the center of the table may be made thinner. Mr. DeLeeuw merely says it is too thin. Why? Won't he have to know how many and how thick ribs I intended to put in before he can figure it? And then where is his rule for figuring the thing anyway?

He doesn't like my way of getting at the size of T-slots, but he doesn't offer any way at all. Where can he get any better proportions of T-slots than those cut to the extreme depth by Brown & Sharpe cutters? The fact of taking these proportions does not necessitate his buying the cutters nor using them. I wanted to have the T-slots run to the edge of the table above the gear. Will Mr. DeLeeuw suggest a better way of getting at it?

RELATIVE WEIGHTS OF PARTS.

Suppose I had written to the Niles Tool Works Company and said: "Gentlemen: I am proposing to build a 6-foot boring mill and I would like to have you send me a list of the weights of various parts." Would I have gotten them by return mail? If I did not I could have bought a mill and taken it to pieces and weighed it, and I might have done the same with a half dozen boring mills for all that Mr. DeLeeuw tells us about it or for all of any book that he refers us to. Then too there might be a possibility that if I knew the proper weights I might distribute the iron poorly within the parts. The proposition certainly strikes me as a queer one, but it may possibly grow out of the pricing of boring mills on a per pound basis.

DEPTH OF BED.

Why does Mr. DeLeeuw object to my getting my depth of bed from other mills and then sandwich it in between advice to get the weights of parts of other mills for comparison and advice to get the proportions of cross rails from other mills? When he puts a foundation under a large mill does he not do it so that the foundation may add some strength to the bed? Can he figure either alone? Why should he make this bed 2 inches deeper? Why not 2½ inches or 3? If he were transported to a desert island with a carload of technical books and suddenly bereft of all memory of boring mills, would he make this deeper or might he make it an inch shallower?

HOUSINGS.

Mr. De Leeuw builds big mills. A 6-ft. mill looks small to him; it looks big to me. If my customer builds a line it will be from 6 feet down, rather than up.

Since Mr. DeLeeuw allows me to use 15 inches for this width if I do not build

up from it, and gives me no reason for not doing it other than that *he* doesn't, I will adopt this table of sizes:

6-ft. mill housing, face 15″
5-ft. mill housing, face 13″
4-ft. mill housing, face 11″
3-ft. mill housing, face 9″

Using these widths rather than others, only half as great will not break either manufacturer or customer and I think will meet with approval of boring-mill hands who have any quantity of work to do high up above the table, where side spring is especially common.

CROSS RAIL.

Suppose we run a vertical cut from the cross rail to the table. If the tool is at the top of the cut the torsion on the cross rail is at its minimum and the twist on the bed between the parts is at its maximum, the stress being transmitted through the work. If we feed down to the table the reverse is true, the torsion on the rail becoming greatest and that on the bed the least. Through the cut the average is the same. The pressure of the feed reacts on the bed as much as on the cross rail. The back of the bed can, of course, be made to add to the stiffness of the front by properly ribbing it, but it has to bear the weight and pressure of the housings, and I also expect to cut it out more or less for gearing, etc., so at this stage of the game I do not want to reckon on it. So far no one has ordered one of these machines with a 10-ft. traverse to the bar, so I will not cross that bridge till I come to it.

BORING BAR.

Mr. De Leeuw ought not to infer from my not having room for either boring bar, or heads, or feeds, or lots of other things in my article, that I intended to dispense with them.

RAISING AND LOWERING THE CROSS RAIL.

Mr. DeLeeuw seems to overlook all the way through that this is only a 6-ft. mill. Comparison with a 30-ft. mill is like designing a 5-h.p. yacht engine on the lines of one for a Cunarder. I am glad, and so undoubtedly are many of the readers of his article to know how these cross rails act on these large mills. But this is another story. Here we have the cross rail guided entirely by one post with a lengthened bearing to properly guide it, and that bearing is long enough to avoid any necessity of getting the center of gravity of the bar and heads in any particular place before raising or lowering. I notice the Niles Tool Works Company build radial drills whose combined weight of arm and head must exceed that on this mill, and yet they only use one screw to raise and lower them. Why not on a boring mill? I do not think and did not say that Professor Sweet recommended this construction for a boring mill, but he did recommend it for another machine which has a similar rail, and at least one traversing head.

Here is another case of a father not recognizing his own son. Mr. DeLeeuw can not see what the cross brace at *m* is for. This is something which I supposed I was borrowing from him. Some years ago the Niles Tool Works Company brought out some small mills in which bed, housings and a brace across the back were cast in one piece. Other builders have braced the back of the housings. This is a separate piece put in for the same purpose. The bolts to hold it will show on the finished drawing. So will a lot of other things, bolts to hold the housings to the bed included.

BEARINGS.

Since I said nothing about the width of the annular bearing I fail to see why Mr. DeLeeuw says that I guessed at it. If he will figure it over he will find it hard to get on load enough to go over 50 pounds per square inch. He wanted me to guess at this load per square inch and also on the total load, but yet he dislikes my methods of reasoning. But from here on he shows signs of not really having read my article which may account for it, as for his misstatement as to the adjustability of the main bearing.

SPEEDS.

Mr. DeLeeuw's statements here are especially misleading. Changing from 3 to 4½ inches as the smallest size for which a speed of 40 feet is to obtained does reduce the entire range one third, but not the gaps between speeds. The speeds which I should have taken would have a ratio, each to the one before it, of 1 to 1.39 if worked out carefully, and with the speeds he suggests the ratio is 1 to 1.34, or a loss of only 3½ per cent. instead of 1/3. Also the highest table speed (circumferential) which I get is 786 feet per minute, instead of 900.

If Mr. DeLeeuw has not discovered that the days of cone pulleys are numbered his salesmen will confirm the statement. But why object to a ratio of 8 to 1 for a pair of spirals? Call them tangent gears and take a pair in practically the same ratio from any worm-gear driven planer.

The principles under which these gears may be expected to be successful were laid down by Mr. Halsey in the AMERICAN MACHINIST of Jan. 13 and 20, 1898, and were that the thread angle should be over 12½ degrees, and that the velocity of the pitch surface of the worm or small gear should be around 200 feet per minute.* Mr. Halsey's conclusions were not challenged. My pair of spiral gears or worm and gear come within these specifications as five minutes' computation will show. Why so horrible? Will Mr. DeLeeuw please explain?

As to the rest of the drive, Mr. DeLeeuw evidently did not read it, for there is a glaring blunder due to the dropping of a cipher which called out no comment.

*The 200-foot limit was an inference by Mr. Lewis.—F. A. H.

For fear that someone may spend the money which he expects to get for this variable mechanism which I left to the reader's imagination, I will say that he had best wait till he gets it. The most superficial glance at conditions will suggest at least one way out of it; possibly not a way entirely above criticism, but one that will work. Two at least of Mr. De Leeuw's successful competitors are using devices which could be extended to cover this point.

WORKING FROM SKETCHES.

A word as to the working from sketches. If Mr. DeLeeuw is able to judge sufficiently well from a mere statement of dimensions how a machine will look he is indeed fortunate, but I fear that he is lonesome. The thing that I like best is a full size sketch on a blackboard, but the AMERICAN MACHINIST will not publish blackboards. Its readers must be used to judging something from the small sketches, and that was my only way of showing what I wanted to show. To those who can judge better by the dimensions stated, they are there too.

CHORDAL TO THE RESCUE.

If I may be allowed to philosophize a moment I would like to quote the following from *Chordal's Letters* as showing the tendency of those already skilled in one branch to object to others breaking into it.

"One of the cant expressions of the narrow-headed mechanic is, 'Every man to his trade!' Such men are very jealous of the success of anyone who slips into their craft edgewise. . . . A good marble cutter will make a better vise hand in a machine shop in one month than a printer will in two years. No mechanic ought to blush to use his own judgment in such matters, and, even after years of hard tugging, go at something which mature judgment of manhood tells will be successful. . . . I say that 'Every man to his trade' is a good motive, and I say that it is every man's privilege at any time in life to find out what his trade is."

THE MILK IN THE COCOANUT.

Coming back now to the real object of my article, to show how little we can get from the machine design books on the subject of machine tools, it seems to me that Mr. DeLeeuw strengthens my position. He speaks more kindly of the books than I do, but he uses them just as little. What he has written is worth more than all that can be found on this subject in all machine design books published. Not because his reasoning is good, but because he is known to be an authority on the subject. But any quantity of experience, valuable as it may be to its possessor, is almost useless to anyone else until it is whipped into shape, averaged with the experience of others and reduced to its lowest terms. Here we have technical colleges dotting the country, all designing and building machine tools (though why I don't know, for less than 1 per cent of their

graduates stick to the business) but not doing anything to advance the state of the art. Here they are in the very best position to do it, but they do not seem to get anything out for us to use.

I am pleased that this article has stirred up discussion, and if that discussion can go on and stir up the technical colleges to reduce current machine-tool practice to a point where an intelligent designer can apply their rules to new conditions with a feeling of safety it will have served its purpose.

We have received from Geo. F Gallagher, of Rochester, N. Y., particulars regarding a recently formed organization known as the "International Congress ot Inventors," of which body Mr. Gallagher is president, and which according to the prospectus, has been established "to aid in the administration of just laws and to endeavor to bring about such changes in existing regulations as may be clearly proven to be detrimental to the great body of inventors of this and other countries, upon the products of whose brains the industries of a commercial nation depend. This organization desires to co-operate in the administration of the patent laws in every country where such laws exist." The entrance fee is placed at five dollars and all inventors are eligible to membership.

In Mexico wood costs less than coal as fuel and oil less than either.

The Calculagraph.

The attention which has, of late years, been bestowed upon piece-work and other systems of payment for labor involving an accurate knowledge of the time expended on each piece of work, has made this an opportune time for the introduction into factories and shops of an exceedingly convenient device which, introduced into the telephone business in 1894, is now a regular part of the standard equipment of telephone switchboards for toll service, all over the world. We give herewith illustrations of this machine, a description of the method of using it in factory time-keeping, and an outline description of its mechanism.

The Calculagraph will print on a card the time of commencing an operation, or of finishing it, or if desired, both of them; this of course could be done by an ordinary time stamp, but it is merely an auxiliary to the main point of the Calculagraph's usefulness, which is as follows: The Calculagraph, by the simple insertion of a card into a slot, and movement of a lever at the beginning and at the end of a period of time, mechanically subtracts the time at the beginning from the time at the end, and prints the difference on the card, in hours and minutes, hours and tenths, minutes and quarters, or the value of the time in dollars and cents, or otherwise, according to which arrangement is preferred when the machine is

FIG. 1. STAMPING A CARD WITH THE CALCULAGRAPH.

FIG. 2. THE CALCULAGRAPH REMOVED FROM ITS CASE.

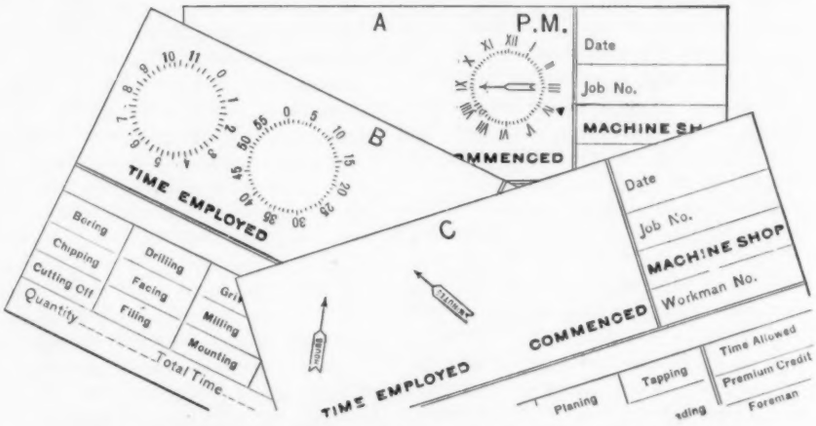


FIG. 3. THE THREE IMPRESSSIONS MADE BY THE LEVER MOVEMENTS.

ordered. It thus eliminates the great chance of error when the elapsed time is determined by clerical subtraction of one written time from another; still more when these notes are made by looking at a clock, not to speak of the possible error due to parallax in the latter case.

Fig. 1 is a perspective view of the machine in use. It will be seen to consist exteriorly of a cylindrical case, having on its upper surface a clock dial, which, however, is merely provided for convenience, as it forms no part of the means for producing the records; an opening along two sides of a heavy plate or platen, allowing a card to be slipped under the platen, as shown; a vertical lever at each side, the left-hand one having one horizontal toe, and a movement on the forward side of the normal position; the right-hand one having two movements, a backward and a forward one, the latter being the one shown in process of execution; this lever has two toes. The instrument can be set on a desk, table, or bracket, mounted on a pedestal, or sunk so that its upper face is flush with the surface of the desk, being supported by hangers provided for this purpose. The latter makes an exceedingly convenient mounting and is the one commonly used in telephone exchanges.

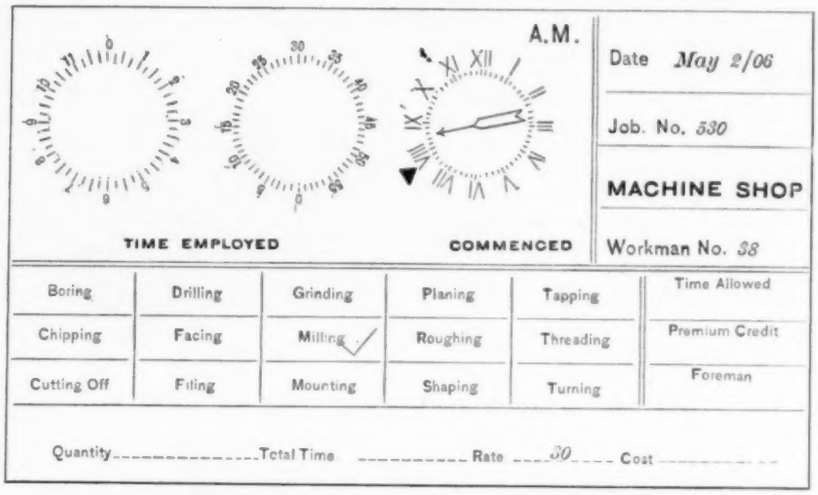


FIG. 4. MACHINE SHOP CARD, HOURS AND MINUTES, FIRST IMPRESSION.

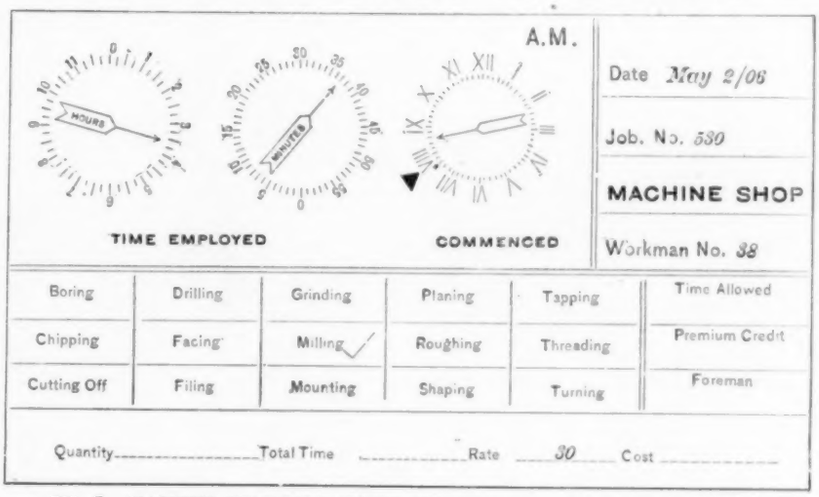


FIG. 5. MACHINE SHOP CARD, HOURS AND MINUTES, SECOND IMPRESSION.

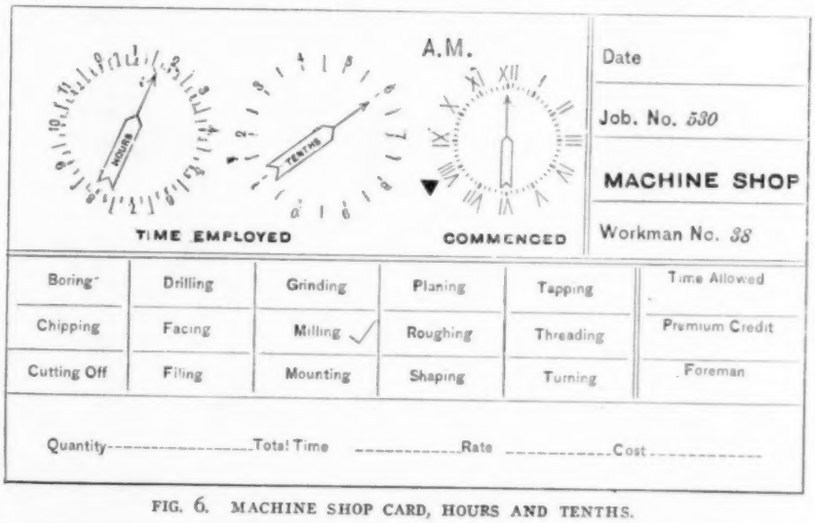


FIG. 6. MACHINE SHOP CARD, HOURS AND TENTHS.

The card upon which the record is to be made is inserted face down, into the slot. At the beginning of the period the right-hand lever is used; at the end the left-hand one. *A*, Fig. 3 shows the impression made by the backward movement of the right-hand lever. This is merely a clock dial with a minute hand inside of it, and a triangular mark to correspond to the hour hand outside, so as to indicate the time of day at the instant the impression was effected; a. m. or p. m. is also indicated. This dial always occupies the same relative position, i.e., with the XII uppermost, while the hands revolve. *B* shows the impression made by the forward movement of the right-hand lever. This consists of two dials, graduated, in the particular machine from which this was printed, to read "hours" and "minutes" respectively, the former reading to quarter hours, and the latter to single minutes. Both these dials keep revolving as long as the clockwork of the machine is kept wound up, so that the positions of the zero points are constantly changing. The left-hand or hour dial (Fig. 3) revolves once in twelve hours, and the one next on its right once in one hour. *C*, Fig. 3 shows the impression made when the left-hand lever is pulled. In this case the three impressions were made one right after another, so no elapsed time would have been indicated were the impressions superposed. In practice, however, the interval of time to be measured intervenes between impressions *B* and *C*. The hour hand and minute hand printed in *C* travel around with the dials of *B*, their points always keeping to the zero marks. Since the two impressions are made at different times, there will be, on the printed record, an arc between the zero points and the points of the arrows, the magnitude of this arc indicating the amount of time which has elapsed between the impressions.

It is of course evident that the factory owner can stamp this record upon any sort of a card that suits him; Figs. 4 and 5 illustrate to a reduced scale a card which is useful in a machine shop. This example, the original of which is 3x5 inches, is the card for the milling work by workman No. 38 on May 2, 1906, on job No. 530, Fig. 4 being the card at the beginning of the job, showing that the work was started at 7.43 a. m.; and Fig. 5 being the

same card after the second punching, showing that 3 hours and 37 minutes were taken to do the work. In this case the filling in of the cost must be done by hand. The machine could be arranged to indicate this cost instead of time, although of course it would then serve for only the hourly rate for which it was constructed. It is evident that between the first and second impressions the machine is free to be employed to stamp as many other cards as may be desired, or as can be put into the slot one after another.

Fig. 6 is an example of a card stamped by a machine graduated in hours and tenths.

At first thought, it might be expected that a machine which would calculate elapsed time would be rather complicated, but after having become acquainted with the method by which it is done, practically a graphical one, it may be perceived that it would not take an exceedingly complicated mechanism to produce this result. The instrument can, by simply taking out a few screws, be readily removed from its case so as to disclose the mechanism. Fig. 2 shows this being done, and gives a general idea of the "works" which are better shown in Fig. 7, which contains a plan, elevation partly in section, and inverted plan, respectively. Fig. 8 is from a photograph of one of the printing dials on its spindle, the dial electrotype being raised above the arrow so as to make its impression on the card, although the difference in levels is so small as not to show very well in the picture. In Fig. 9 the arrow or pointer is raised up to print; the condition here, however, is just the opposite of Fig. 8, the photographer having slid the hand up so far as to greatly exaggerate the amount of travel. Fig. 10 is supplementary to Fig. 7, and shows in vertical section the two dials which record the elapsed time, which for convenience we shall call the "subtracting dials." The machine shown in Fig. 7 is one of those used in telephone work, the middle dial of which makes a revolution every 60 minutes, and the subtracting dial on the end a revolution every 5 minutes, the graduations being for 5-minute intervals and ¼-minute intervals, respectively. It will therefore be seen that the dial at the end revolves twelve times as fast as the middle one; the arrangement of the gearing in this machine is therefore the opposite to that in the machine which made the impressions illustrated in Figs. 3, 4 and 5, in which the end dial revolves at one-twelfth the rate of the middle one, the speed of the middle one being the same in both machines. This should be borne in mind in reading the following description, in which the subtracting dials will be spoken of as middle dial and end dial.

The machine, in order to get sufficient power, is driven conjointly by two mainsprings upon the axes *A*, *B*, see plan, Fig. 7; they are not shown in the eleva-

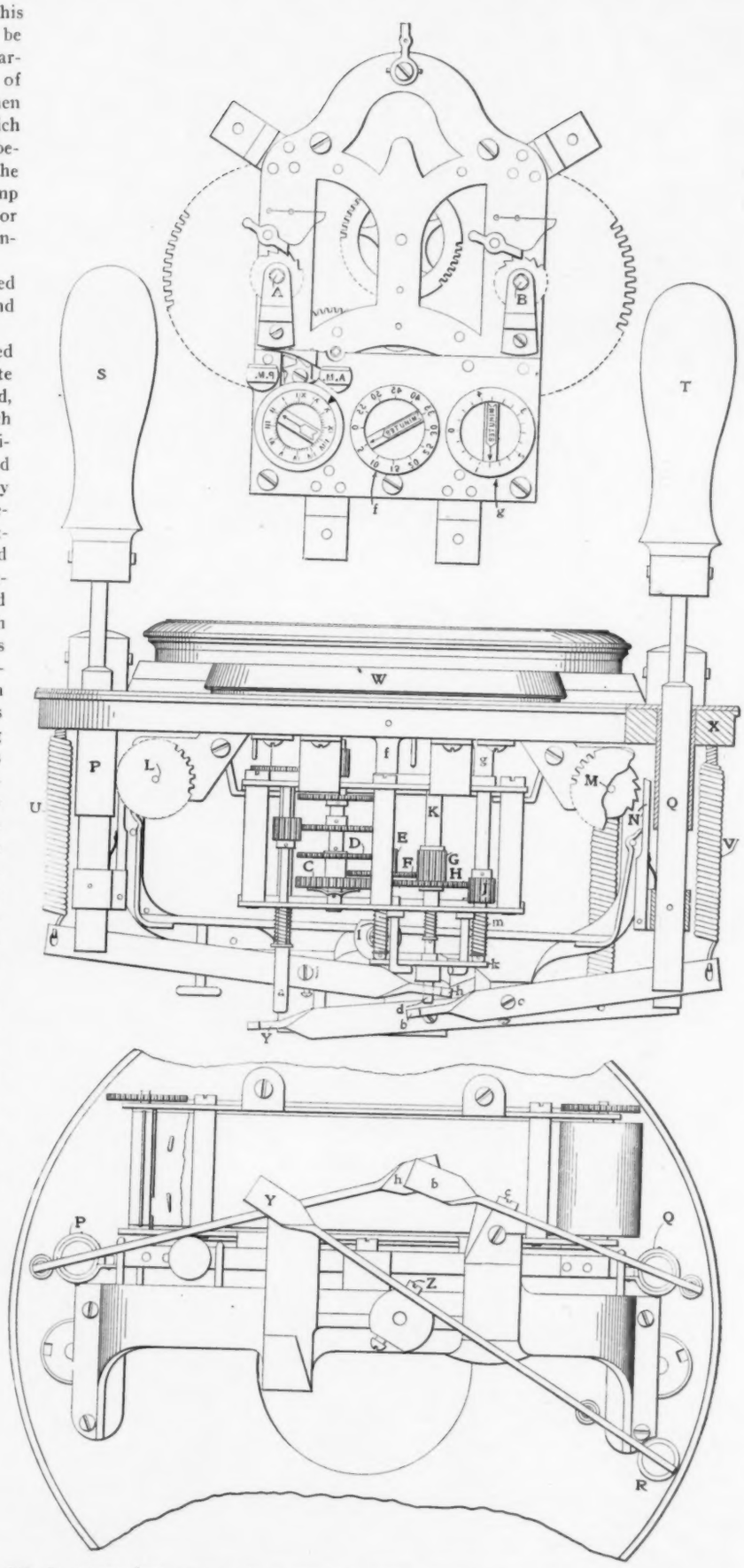


FIG. 7. PLAN (TOP REMOVED), ELEVATION AND INVERTED PLAN OF THE MECHANISM.

tion, but they drive the wheel *C*. The wheel *D* on the same axis drives the pinion *E*, which is scarcely visible in the cut; it is on the axis of the middle dial. On the same axis is the gear *F*, which drives the pinion *G* and wheel *H* which is fast to *G*; *H* drives *J*, which is on the end

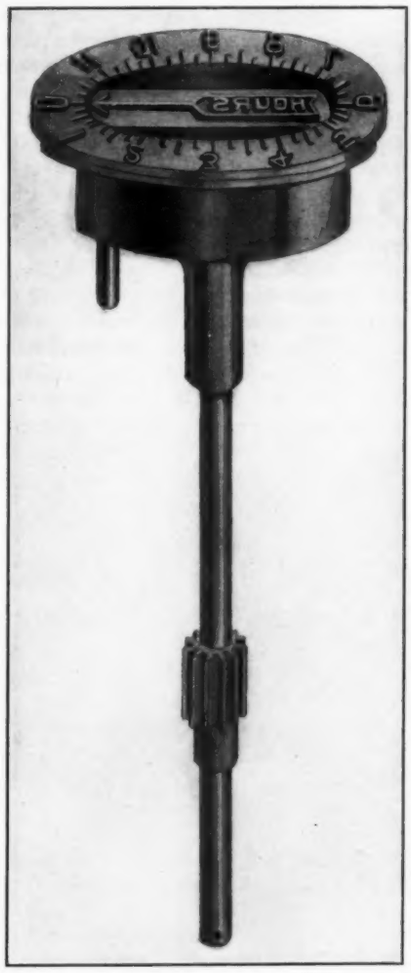


FIG. 8. POSITION OF ROTATING ELECTROTYPES IN PRINTING THE DIALS.

dial spindle. In addition to this there is an escapement like that of a watch, and some gearing, a portion only of which appears in the upper left-hand corner of the mechanism in the elevation Fig. 7, and which operates the time-of-day hands and the a.m. and p.m., the latter of course changing every twelve hours. The ratchet wheels on the horizontal axes *L* and *M* are for operating the ink ribbon, being pushed around by pawls, one of which is shown, out of action, at *N*; these pawls are moved by the up-and-down motion of the plungers *P* and *Q*, which, as well as the plunger *R*, are pushed down by the movement of the levers *S* and *T*, and pulled up again by the springs *U* and *V*. As in the case of a typewriter, when the ribbon has made a complete traverse and is all wound on one spool, its direction of travel is reversed by throwing one pawl out of action and throwing the other one in, by a simple device. The ribbon passes over the dials and pointers, and above it is the space for the card, and above that is the platen *W*, which is lined on its lower side with rubber, against which the card is pressed when the impressions are being made upon it. This platen is fixed to the cover plate *X*, which forms the main supporting plate of all the mechanism.

We will now consider the means by which the impressions are effected. First, the backward movement of the handle *T*, by means of the back toe at its lower end, causes the plunger *R* to move downward, and causes the end *Y* of the lever fulcrumed at *Z* to move up and push up the spindle *a*, causing the time-of-day stamp to be imprinted on the card. Then the forward movement of the handle *T*, by means of its other toe, presses down the plunger *Q*, causing the end *b* of the lever fulcrumed at *c* to move up, and with it the spindle *d* carrying the cross bar *e* at its upper end (see Fig. 10). The latter presses up the printing dials *f* and *g*, so as to print on the card. The third movement, made when the card is inserted the second time, is accomplished by moving lever *S*, which forces down

FIG. 9. POSITION OF ROTATING ELECTROTYPES IN PRINTING THE POINTER.

the plunger *P*, and up the end *h* of the lever having its fulcrum at *j*, and through which the stem *d* passes, also moving up the crossbar *k*, Fig. 7, without moving *d*, but elevating the spindles *l* and *m*, Figs. 7 and 10, carrying on their upper ends the printing arrows, which are caused to revolve with the corresponding dials by the pins *n* and *p*. These vertical movements are allowed for without interference with the gearing by means of the

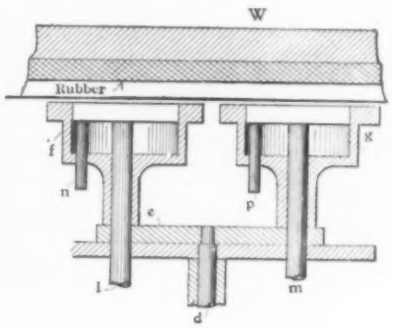


FIG. 10. VERTICAL SECTION THROUGH THE SUBTRACTING DIALS.

wide-faced pinions. Springs are provided to return the parts to their normal positions. The levers are always to be moved as far as they will go, the stops being so located that any additional pressure is taken by them and thus there is no danger of injury to the logotypes. The movement of the levers should be steady, not a blow.

This instrument is made in quite a variety of styles by the Calculagraph Company, Henry Abbott, President, 1425 Jewelers' Building, 9—11—13 Maiden Lane, New York City.

Staten Island is responsible for an oddity in barometers, the "rope barometer." It has been displayed in a conspicuous place at the municipal ferry house, St. George, and consists of a white placard, appropriately inscribed, with a piece of rope about a foot long dangling in the middle. The barometric phenomena are explained in the following legends: If rope is dry, fair; if rope is swinging, windy; if rope is wet, rain; if rope is wet and swinging, storm; if rope is frozen, cold.—*New York Sun.*

The Merchants Association of New York has issued a pocket guide to New York, which, with its good maps, and its pages of condensed information, is an excellent thing for visitors to the city, who wish to see its chief points of interest without waste of money and time. The guide is sold at 10 cents by the association named, which is now located at 6672 Lafayette street, New York.

The Engineer (London) has perpetrated a joke as follows: Water-finding or "divining" is usually accomplished by means of a hazel twig. One expert, however, is said to make use of a watch spring. It is probably out of a Waterbury watch.

A Corliss Cylinder Boring Machine.

The illustrations show various views of a machine which has been recently built by the Barrett Machine Tool Company, of Meadville, Penn., for the Allis-Chalmers Company, of Milwaukee, Wisconsin.

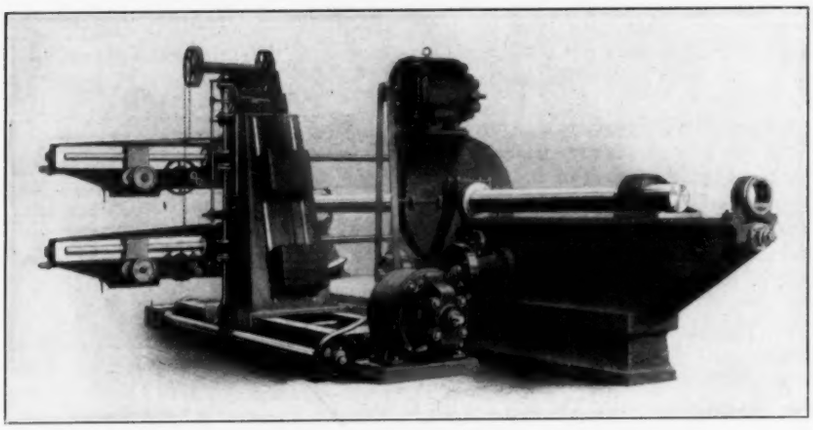


FIG. 1. SHOWING MOTORS AND DRIVING MECHANISM.

This machine was designed for simultaneously machining the bore, valve chambers and flanges of corliss cylinders up to 36 inches bore by 8 feet long.

The main bed of the machine is 23 feet long. By referring to Fig. 3, it will be seen that one end of the bed is widened out to accommodate the work. This widened portion is 15 feet 7 inches long by 48 inches wide, and is 18 inches high. It is provided with T-slots for securing the work; 13 of these run across its surface, and two run at right angles to the others, the entire length of the platen.

Secured to the narrow portion of the bed are the main boring-bar guides, driving gear and feed mechanism. The main boring bar is of hammered steel, 8 inches diameter, the centers of the pedestals in which it runs are 36 inches from the face of the platen, it has continuous feed travel in either direction of 8 feet 4 inches, and is provided with quick traverse in either direction by power.

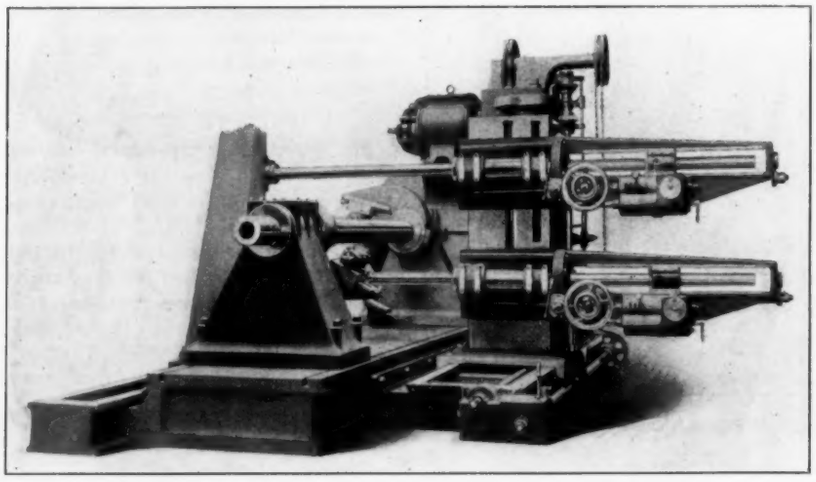


FIG. 2. SHOWING BORING BAR SPINDLES AND FACING HEADS.

Power is transmitted to the bar by a Hindley single-thread left-hand worm and worm wheel having a ratio of 100 to 1. The power is supplied by an independent Bullock 25-h.p. variable speed motor, giving variations of speed from 300 to 1200 r.p.m. The motor is mounted on top of the worm pedestal hood, and drives the worm shaft through silent running chain and sprocket wheels.

The feed box mechanism with which the machine is equipped, permits of fourteen different gradations of feed, any one of which is almost instantly obtainable. The facing heads are mounted on sleeves in the boring bar supports, thus facing and boring may proceed simultaneously. On either side of the main bed, and attached to it are sub-beds which carry adjustable columns. The main column—a rear view of which is shown at Fig. 1 and a front view at Fig. 2—can be moved by power to permit any port to be bored.

The main column carries two vertically adjustable saddles to which power is communicated through silent running chain and sprockets from an independent Bullock 20-h.p. variable speed motor having a range of from 300 to 1200 r.p.m. The position of this motor is shown at the end of the sub-base in Fig. 1.

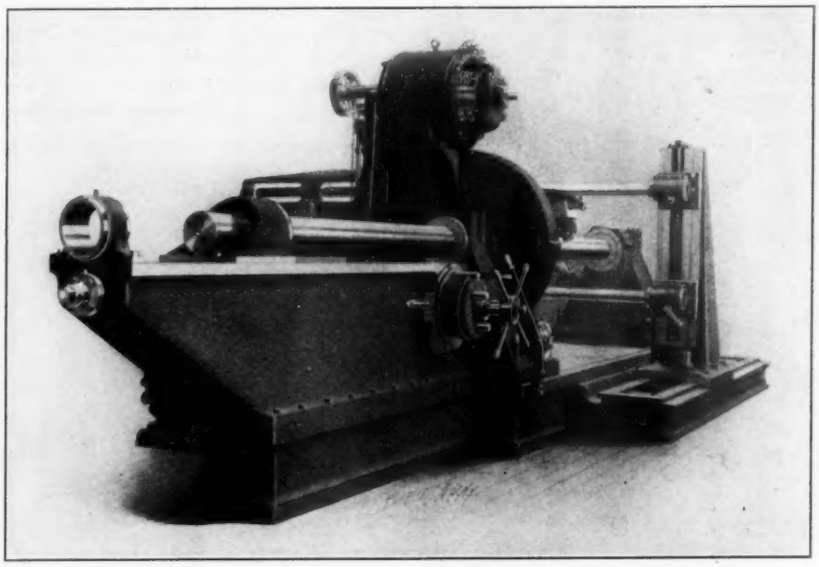


FIG. 3. REAR VIEW OF CORLISS CYLINDER BORI NG MACHINE.

The drive for the spindles is similar to that of the main boring bar, i.e., through Hindley worm and worm wheel, but with left-hand double-thread worm, the ratio of the worm and wheel being 19 to 1.

The saddles are independently adjustable for hight. The column and outboard supports of the machine are graduated so that the heads can be set to the dimensions on the drawing, thus avoiding unnecessary trouble in measuring. All movements of the heads and columns are by power.

The valve-boring spindles are 3¼ inches diameter with a taper hole in the end of each of them for admitting smaller bars when necessary. By means of a friction clutch the spindles may be operated together or independently. They have eight gradations of feed, from 1/32 to ½ inch per turn; any one of these feeds

may be almost instantly thrown into action by means of the quick change feed mechanism. A quick traverse by hand for these spindles is also provided; it operates through hand wheel, helical gears and screw.

The total weight of the machine is 60,000 pounds.

Grinding Machine for Large Ball Races.

We illustrate herewith a special machine recently built by the Pratt & Whitney Company, of Hartford, Conn., for grinding large ball races and rings used on pedestal gun mounts.

The machine is designed for grinding parts of this class ranging from 12 inches inside to 40 inches outside diameter, and whose faces are 3½ inches or less in width, the maximum thickness provided for being also 3½ inches.

The half-tone Fig. 1, and the general drawing, Fig. 2, give an excellent idea of the machine as a whole. Fig. 3 shows more clearly the construction of the head. It will be observed that the driving of the main spindle is effected through the medium of a four-step cone geared to the spindle and the latter carries a large face plate (52 inch) on which the work is held at six points by either external or internal clamps pivoted to the jaws, a three-point bearing compensating for irregularities in the forgings. The spindle runs in babbitt-lined bearings, the front journal being 4½ inches in diameter by 6½ inches long, and the drive is by a 3-inch belt; the cone steps range in diameter from 6 to 12 inches, and the spindle—which is geared from the cone shaft in the ratio of 1 to 6—has four rates of speed ranging from 6 2/3 to 26 2/3 turns per minute.

Three grinding heads are provided and two of these are mounted on the main part of the bed. The one at the right end is for grinding the channel or race in the ring, and the one to the left for grinding the face, while the third, which is car-

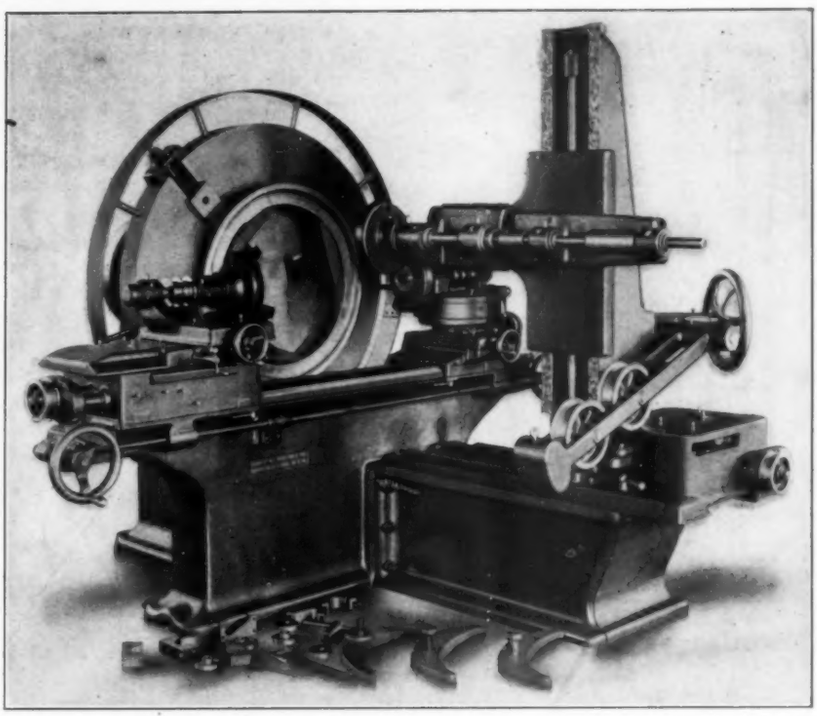


FIG. 1. GRINDING MACHINE FOR LARGE BALL RACES.

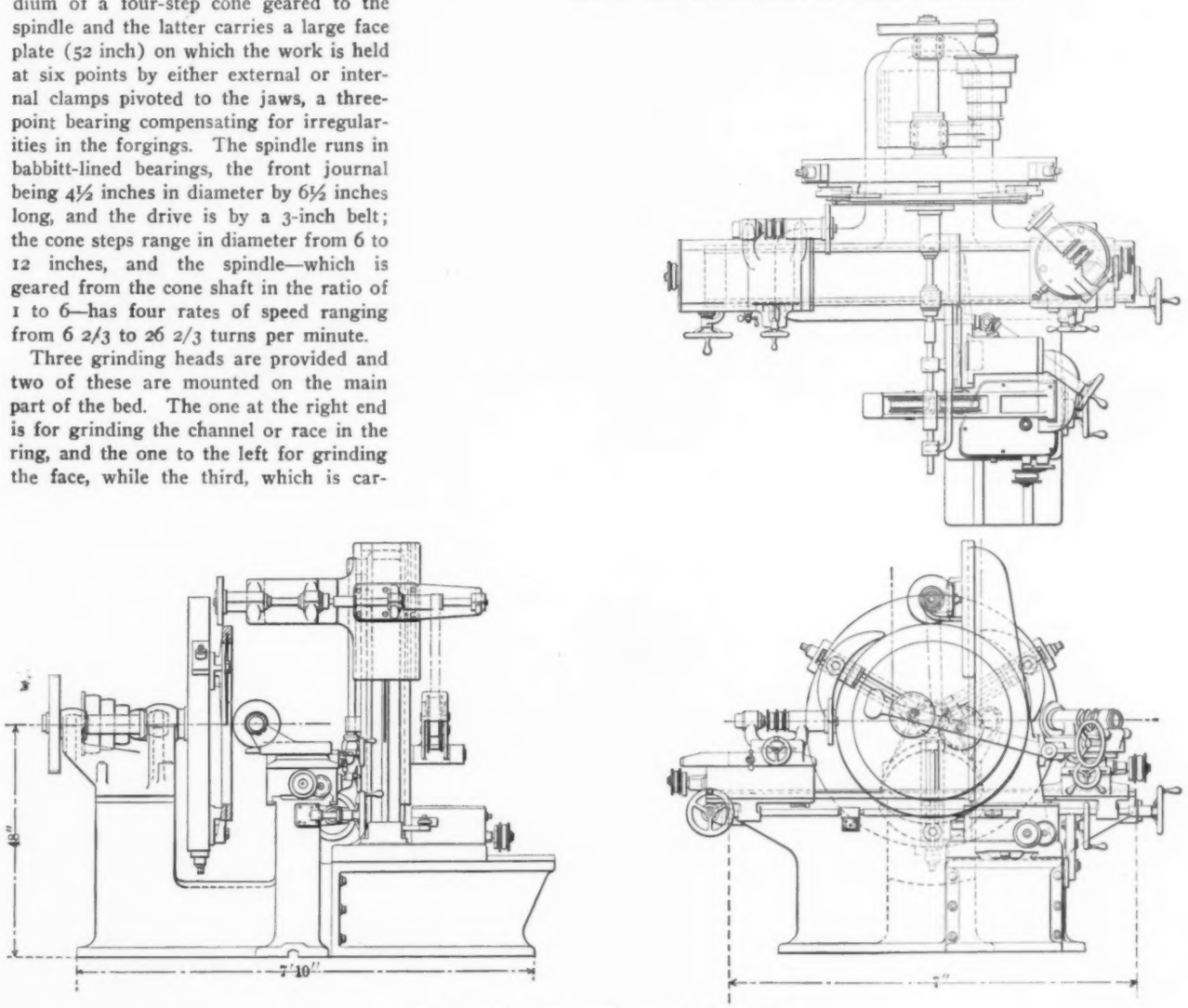


FIG. 2. PLAN AND ELEVATIONS OF GRINDER.

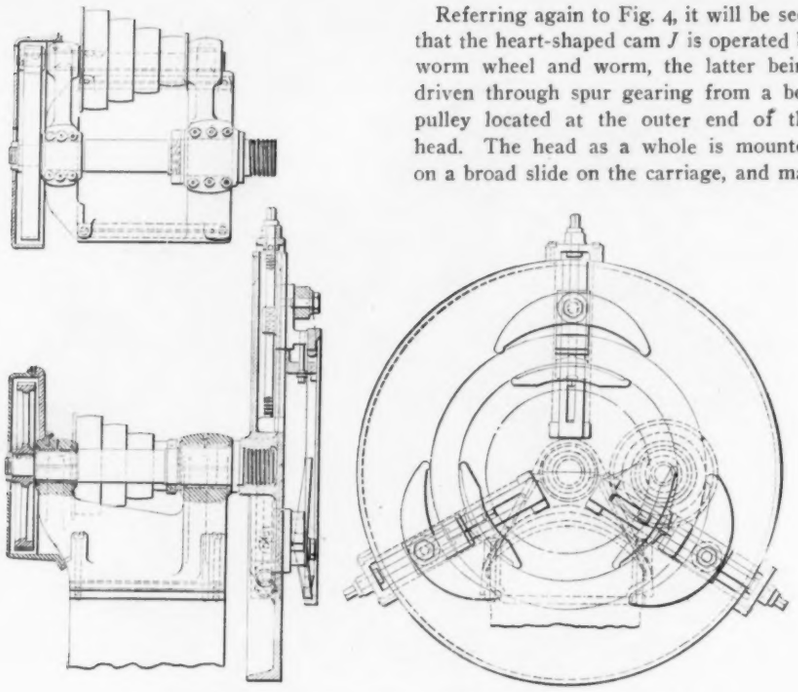


FIG. 3. SHOWING CONSTRUCTION OF HEAD AND FACE PLATE.

ried on the column, finishes the periphery and the interior or bore of the work.

The head for grinding the ball race is aranged as in Fig. 4. As is shown, its spindle is supported in bearings upon a circular cap at *A*, which is hinged to a head adapted to swivel at *B*, and by releasing two clamp screws and raising the cap, access is readily had to the mechanism inside when changing for different pieces of work. Between cap *A* and swivel base *B* are interposed two dovetailed slides, *C* and *D*, which are designed to work at right angles to each other, and the upper of which forms a part of circular case *E*. This slide is fitted in a guide formed in the top of lower slide *D*, and the latter is dovetailed at its underside to suit a guide machined across swivel plate *B*. A hardened former *F* which determines the shape of the race ground out in the work is secured to the upper slide and contact between this former and the hardened and ground roll at *G* is maintained by means of spring *H*. The lower slide is provided with two rolls, *I*, which work in conjunction with a heart-shaped cam *J*, in order to give the apparatus the required travel.

As the cam and the two rollers impart to the lower slide a reciprocating movement, the former *F* pressed always against roll *G*—whose axis is stationary—causes the upper slide and the grinding wheel to follow the path required for grinding out the race. One of the formers is shown to larger scale in the detail Fig. 5. These hardened guides are made interchangeable in the seat under the upper slide, and it is obvious that they may be shaped to control the grinding of any curve desired as well as bevel faces of any degree of angularity.

Referring again to Fig. 4, it will be seen that the heart-shaped cam *J* is operated by worm wheel and worm, the latter being driven through spur gearing from a belt pulley located at the outer end of the head. The head as a whole is mounted on a broad slide on the carriage, and may be adjusted transversely a distance of 6 inches for setting the wheel to the cut. The carriage can be moved along the bed by hand wheel and screw, and the grinding-wheel brought into service at either side of the work.

The head for grinding the faces of the rings is shown in Fig. 6, and is mounted on a slide having a hand adjustment in and out of six inches; the carriage carrying this slide is adjustable along the ways by a hand wheel at the left-hand end of the bed. The wheel head is reciprocated past the work by a worm-driven cam *K*, located inside the carriage, this cam acting upon a rocker arm *L* which is so arranged as to give a variable length of stroke adjustable from 0 to 5½ inches by means of a crank handle at *M*. The cam is driven in the same manner as the one used in the head at the other end of the bed.

The arrangement of the head for grinding the inside and outside of the work is clearly illustrated in Fig. 7 and consists of a dovetailed slide *N*, mounted on an overhanging arm forming part of a saddle

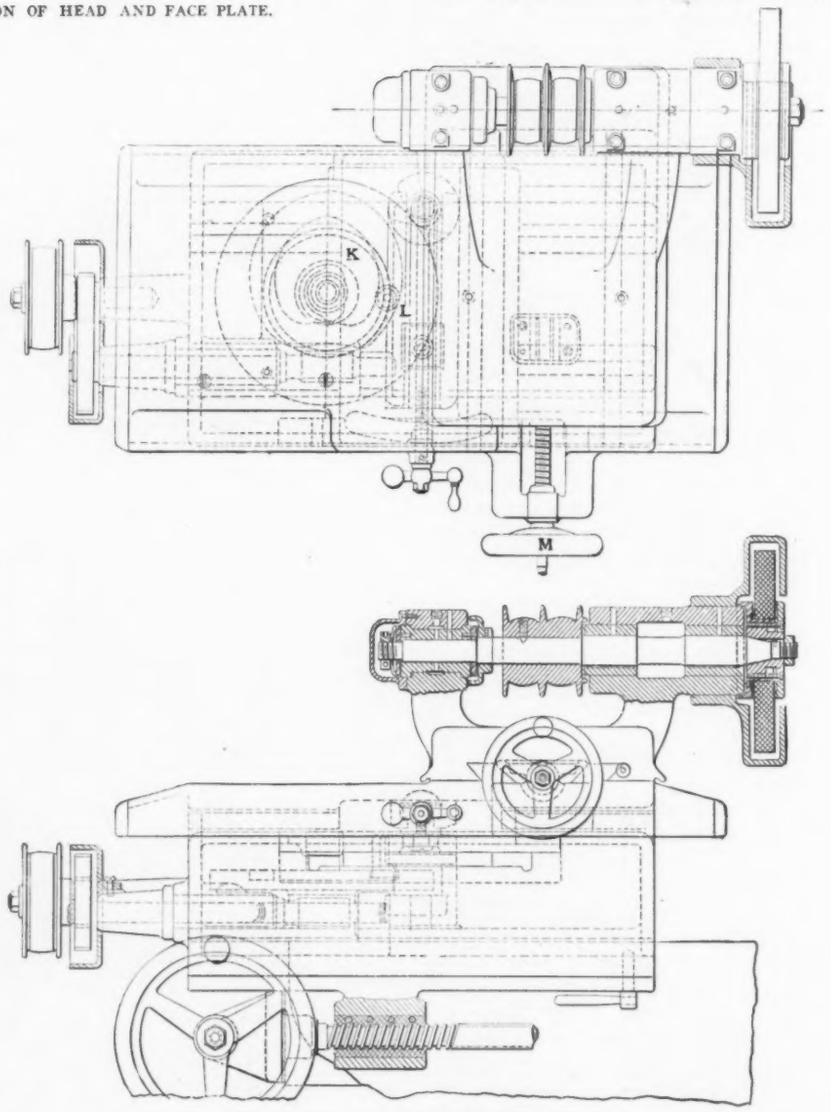


FIG. 6. HEAD FOR GRINDING RING FACES.

which is fitted to the face of the vertical column. This column is mounted on a base securely bolted to the front of the grinder bed and has a movement of 23 inches by rack and pinion enabling the head to be drawn back out of the way in order to allow the belts on the race-grinding head to clear when that head is being moved from one side of the machine to the other. On the base of the upright itself a box *A* is mounted containing (as shown in the enlarged detail) a worm-driven cam *P* which through the bell crank *Q* operates a rack which meshes with a pinion feathered to a vertical shaft *R* in the column. A gear segment is also located on this splined shaft, and acts in conjunction with a rack fixed to the back side of the sliding head *N* to impart to the head and wheel a reciprocating movement. This traverse may be varied from 0 to 5½ inches by adjusting the sliding blocks *S* in the rocker *Q* located in the cam box at the foot of the column. This adjustment is readily made by means of a crank handle which fits the square-head screw projecting through a slot in the wall of the case.

The saddle carrying the wheel slide has a vertical movement of 26 inches upon the upright to accommodate the range of work diameters specified. The vertical adjustment is secured by an elevating screw at the rear of the column, which screw is operated through a hand wheel and connecting bevel gears. The saddle carries also a bracket in which is mounted a driving shaft in line with and coupled to the wheel spindle. This shaft is provided with a 3-inch belt drum 8 inches in length and an idler system is arranged as shown to maintain an even tension on the belt when the head is raisad for different diameters of work.

The spindles in the three grinding heads are practically alike as regards general dimensions, type of bearings, etc. The front bearings are 1½ inches in diameter and the spindles are ground to run in bronze bushings which are adjustable to compensate for wear. The bearings are protected by dust caps and spindle end thrust is taken up by spring pressure at the rear end. The two spindles whose carriages are mounted on the bed proper are each driven from a drum overhead by a pair of 1¼-inch belts passing over pulleys 3¼ inches in diameter. The spindles are adapted to run at from 2500 to 3000 turns per minute. The three driving pulleys for the cam mechanism in the three heads are actuated by 1¼-inch belts and are 5 inches in diameter.

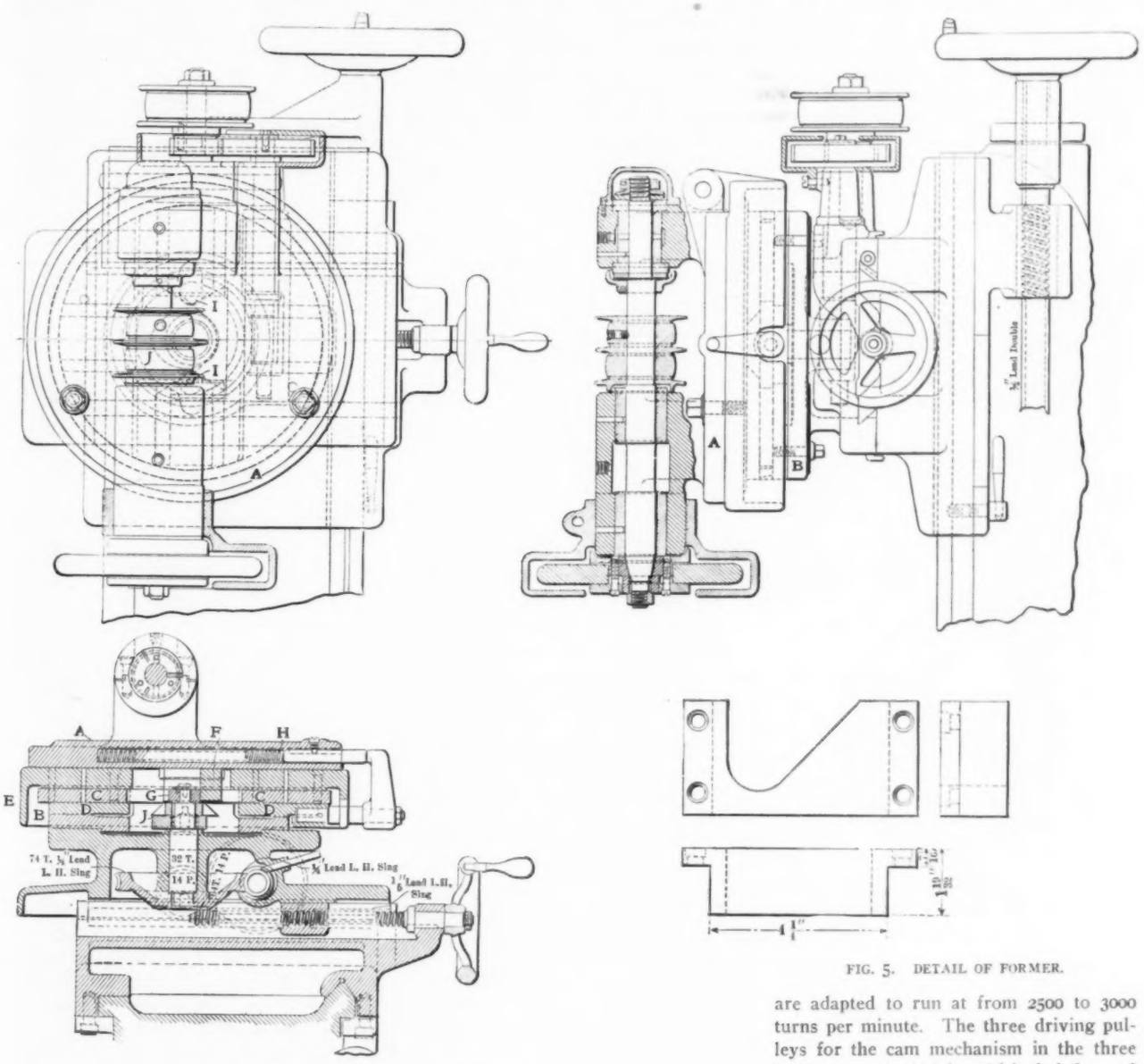


FIG. 4. HEAD FOR GRINDING BALL RACE.

FIG. 5. DETAIL OF FORMER.

According to Consul Harris, of Mannheim, reports have been published there showing that the new German tariff on food stuffs has led to a very greatly increased consumption in certain parts of Germany of horse meat and of dogs; 2405 of the latter having been slaughtered for food during the fourth quarter of 1905, as against 1762 during the same period of 1904.

The Question Of Men and Salaries in the Drafting Room.

BY GEORGE F. SUMMERS.

It is thought that the readers of the AMERICAN MACHINIST who work in the shop greatly outnumber those who are in the office or drafting room, and from questions put to me by young shop men who are taking correspondence courses or older men who are planning futures for their boys, it would seem that the qualifications necessary to become an acceptable draftsman and the probable pay after one has secured such a position are items of keen interest to enough of the subscribers to the paper to warrant the publication of a short article telling of the conditions as they exist.

THE PAY OF A DRAFTSMAN.

A great many popular papers publish from time to time articles telling of the fabulous pay and wonderful positions that a young man of ambition, etc., can get by mere energy. As a matter of fact such opportunities do not exist and never have existed except for men of rare and peculiar ability, or as is generally the case, with cash capital. It is therefore thought that figures, necessarily general but truthful and to the point, would be of more value than the more pleasant reading that tells of what one would like to have true.

Draftsmen are paid by the year, by the week or by the hour. If by the year it is customary for the firm to practically insure the employee against loss from time lost while sick or from other causes, giving him a certain lump sum for such work as he may be able to give in the course of the twelve months. On the other hand the overtime that all draftsmen must work, sooner or later, is the company's gain, for the employee gets nothing extra for it. It is to the employer's interest to pay in this way as the risk he runs is really small, and the price he gets for this insurance is large; also, a very important factor, he makes the positions more desirable and he is therefore able to hold his men and the money he spends in training a draftsman to do the work peculiar to his business is not so likely to be lost by the draftsman leaving.

The following table shows the wages per week or the pay per hour that are equal to a yearly salary.

Salary Per Year.	Wages Per Week.	Pay Per Hour.
$1800	$38	78c.
1700	36	74
1600	33	70
1500	31	65
1400	29	61
1300	27	57
1200	25	52
1100	23	48
1000	21	44
900	19	39
800	17	35
700	15	30
600	13	26

In the course of a year the following days may be counted as unavailable for work:

52 Sundays	52
New Year's Day	1
Washington's Birthday	1
Memorial Day	1
Independence Day	1
Labor Day	1
Thanksgiving Day	1
Christmas Day	1
Vacation	14
Days necessarily absent	5
	78
Working days	287
	365

Which leaves about 287 working days for the employer and the rate per day multiplied by 287 will give the actual income of the employee as shown in the following table.

If we assume that an employer will lose his man's time for 52 Sundays and seven holidays—that he will grant the employee two weeks' vacation in summer at full pay, and on an average let him off five days in a year to go to a ball game or to the dentist, and he will have a net 287 days' labor for, say $1200 expended.

If a draftsman is paid otherwise he must get $25 per week or 52 cents per hour, to give him the same sum in a year, allowing eight hours per day and six days per week. In taking on a new man it should be made clear just what system is used in paying, as a so-called $1200 job, where the man is required to lose all time away from work, is really a paid-by-the-hour job, and is equal to, not $1200, but about $1090, yearly salary.

THE DRAFTSMAN'S VALUE.

A draftman's value to a concern is really a great deal more than his salary, but the latter being fixed by the supply of men, is necessarily low, as, like any other purchase, the manager should buy as low as he can. On the other hand, the higher priced men are worth a great deal more in propotion than the lower priced employees, and when such a man gets to a point where he is really valuable, the firm can well afford to pay him well to keep him. A draftsman's work is peculiar in that it affects the whole line, whereas a machinist's affects only the part in which he is working. For example, a draftsman working on the drawing of a

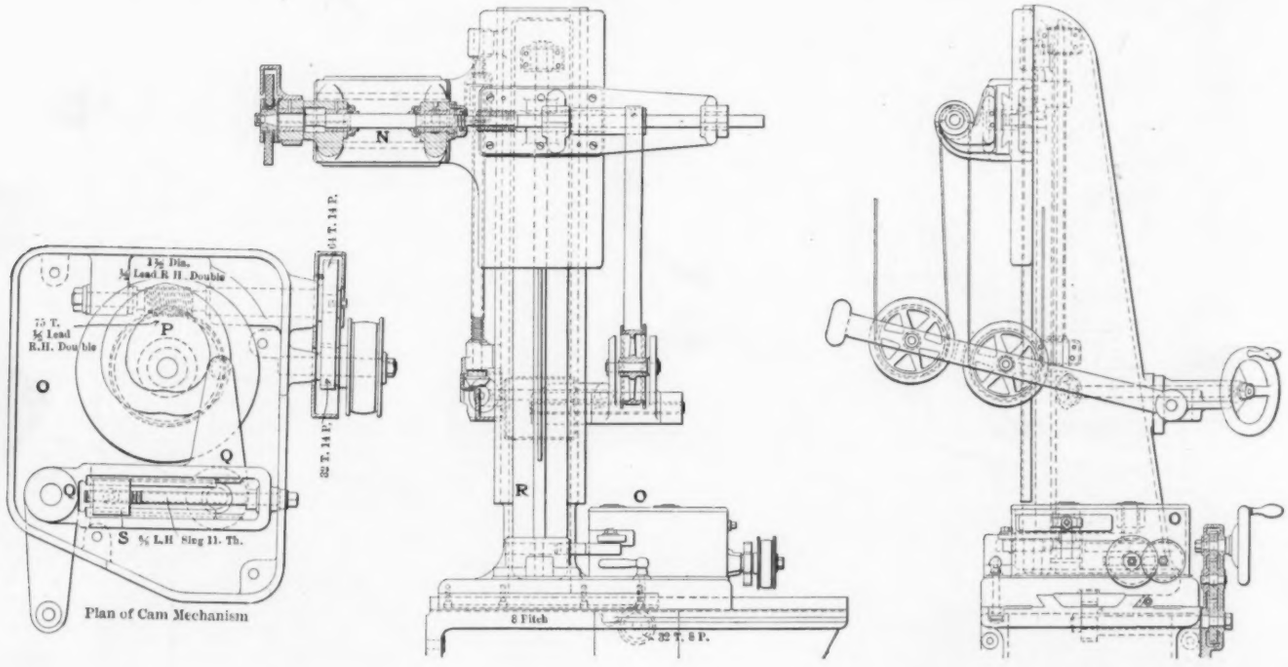


FIG. 7. HEAD FOR GRINDING INSIDE AND OUTSIDE OF RINGS.

pump will control the details of hundreds of thousands of dollars worth of pumps that will be made from his tracings, and his charge for labor is so small in comparison, that it is quite clear that it would be foolish to jeopardize the big item by trying to cut down the insignificant one.

THE EXPECTATION OF INCREASE.

The salaries, that is, the market value, of draftsmen today run from $300 to $1500 and are shown graphically in the diagram. Suppose for instance a boy starts in when he is through school, at 17 years of age. He can command about $300 per year. He will not be worth that much, but that is his market value, and it is paid him largely in the expectation that he will learn, and in time become a man whom the concern can get for much less than his real value. If the manager cannot see his way clear to keep the boy by making his job desirable, it would be much better, of course, to employ a high priced man at once; and that is just what

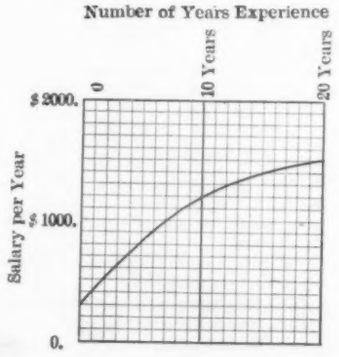


DIAGRAM SHOWING THE EXPECTATIONS OF ADVANCEMENT A BOY WITH A PUBLIC SCHOOL EDUCATION MAY HAVE ON ENTERING THE DRAFTING-ROOM.

a good many firms are doing. During the boy's first year he will be little else than a source of trouble and annoyance. He will not be able to take responsibility, his tracings will be crude and his work slow. Generally the time spent by the chief draftsman and his assistants in going over his work will very much exceed its value.

But in five years, or when he is 22, he will become a very fair draftsman, and his income will advance to about $800. After ten years' service, or when he is 27, he may have an expectation of earning $1200, and when he reaches 37 after 20 years of service, he will get about $1500.

These figures may seem small, but when it is considered that he spent no money in education nor time in apprenticeship, without pay, and that his job is light, clean, desirable work, the price is fair.

SHOP MEN AS DRAFTSMEN.

Concerning the advisability of taking men from the shop into the drafting room, if a machinist understands his business, and is still young, that is if his fingers and especially his mind are quick and versatile, he makes the very best possible material for a draftsman, and a firm should have no hesitancy in putting him in the drafting room at once at the same rate of pay he is getting in the shop. The actual knowledge of drafting which he will need, he can readily pick up in a few months, although a correspondence school course will undoubtedly help him. On the other hand, if a machinist's fingers are stiff, and he has not the equivalent of a high school education, or if he is getting along in years, being say, thirty years old, he will not be able to compete in quickness, with the young men, and the advisability of taking him into the drafting room is very doubtful. Of course there are exceptions, and when a man by working nights under adverse conditions does make a success, he is clearly entitled to that much more respect from us all.

TECHNICAL GRADUATES AS DRAFTSMEN.

Periodically in every drafting room, the question comes up of employing new men. In fact nearly every manufacturing plant of any importance has a standing demand for men—if they can get bargains. It is then often a point of importance to decide what kind of a man is best to use. Contrary to popular opinion college men do not make desirable draftsmen; that is, a man who has spent $3000 on his education must get interest on his investment, and wants to be paid for what he knows, whether it is being used by the firm or not. Therefore, unless the position has enough of a future to make it ultimately high priced, it is better to get a man all of whose knowledge can be used than one who gets paid for part only of his education, and who will naturally soon be looking for a place where he can make capital of it all.

WHAT A DRAFTSMAN SHOULD KNOW.

It is often asked if a man must know mathematics to be a draftsman. In choosing men, if an applicant has that knowledge, so much the better, but if not, it is no great harm, for the computations most draftsmen have to make are few and simple, their work being more a question of good judgment than mathematics, and anything of importance can be determined by those higher up.

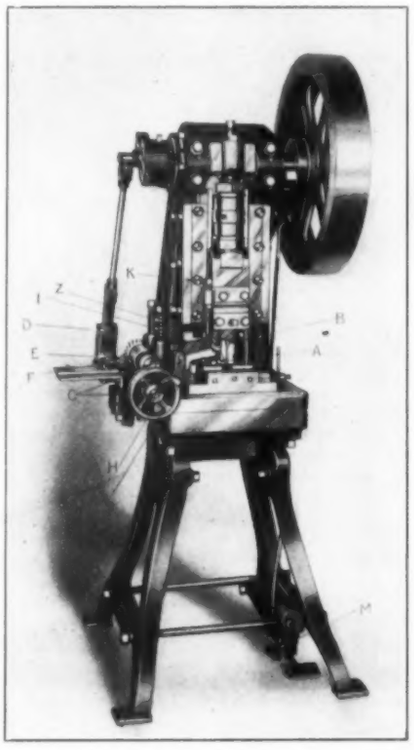
What a draftsman must know is this: He must first have a clear conception in his mind of the work he is to design; he must then be able to lay down in pencil on paper the details, creating them easily, and accurately, step by step, as he goes along; he must then by a system of diagrams in ink on tracing cloth prepare for the shop a series of orders, plain, neat and without errors, from which the shop can build the work.

Electrobus and *petrolbus* are not, as might seem, words from the ancient classical authors, but are late English coinages meaning an electrically and a gasolene-propelled omnibus, respectively; we do not think they will delight philologists.

A Press with Special Feed for Making Staples.

The accompanying illustration represents a small automatic press with special feeding device for making flat wire staples. The machine takes the stock from the roll and carries it under the punches *A* and *B* by means of the single-roll feed *C*, producing at each stroke of the press a finished staple which falls through the press bed into a box placed there to receive it.

The roll-feed is operated by the rack *D*, which meshes in with the small pinion *E*. This pinion operates a bevel gear keyed to the same shaft. The bevel gear engages with a corresponding gear on the shaft of the lower roll which drives the upper roll in the opposite direction by means of the



A PRESS WITH SPECIAL FEED FOR MAKING STAPLES.

gears *F*. The upper roll is held in position by the studs *Z* and swings on the rod *H*. Proper tension on the stock is obtained by the springs *I*. In order that there may be no drag on the stock while the punches are doing the work the set screw *K* is provided to raise the rolls at about the time when the punches reach the stock. *M* is a treadle lock used when it is desired to run the press continuously.

The cutting punch is a separate piece *A* which is forced down by a plain punch fastened to the slide of the press and is raised by a small spring *L*. The cutting punch cuts off the wire at an angle so as to produce a sharp point on the staple. *B* is the forming punch.

The press makes about 75 complete staples per minute without any handling

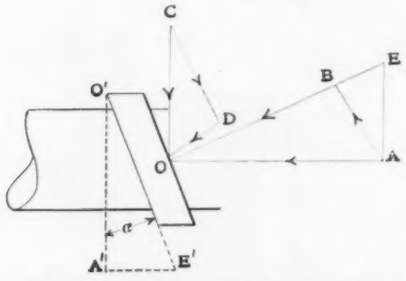
whatsoever on the part of the operator. The machine is small and compact and altogether does not weigh more than 750 pounds.

It has been built by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

Worm-Gear Design.

BY A. M. SOSA.

The treatise on Worm and Spiral Gearing, by F. A. Halsey, is undoubtedly a valuable collection of data for the designer. It explains clearly the efficiency of these gears, the influence of the angle and the velocity. The table on page 37, from experiments made by James Christie, contains the most definite known data on this subject. Still, the design of worm gearing is a matter of uncertainty. The principles so far established remain to be formulated. The most important



OA = load on wheel = W. BO and AB are its components.

$EOA = E'O'A' = OCD$ = angle of thread = α.

CO = active force of worm. CD and DO are its components.

$A'O' : A'E' ::$ pitch line velocity of worm : pitch line velocity of wheel $:: AO : EA$.

And as the velocities are in inverse proportion to their respective forces:

$AO : AE :: W$: active force of worm, consequently force of worm $= W \tan. \alpha +$ the necessary surplus for efficiency $= W \tan. (\alpha + \beta)$.

Making $CO = W \tan. (\alpha + \beta)$ we will have $DO = W \tan. (\alpha + \beta) \sin. \alpha$, and on the triangle ABO:

$BO = W \cos. \alpha$.

$DO + BO = P$ in formula (2).

The components CD and BA are in line for action and reaction.

FIG. 1. DERIVATION OF FORMULA (2).

point is to ascertain the maximum allowable pressure for a given speed, before these gears start heating and cutting. Very high speeds may be successfully used if accompanied by very light loads, and *vice-versa*.

As the problem presents itself it deals with both pressure and velocity, and the necessary data are not found in books, to my knowledge, except in a very elaborate form. What the designer needs is a very simple way of computing the pitch and lead of a worm for a given load and speed. The object of this article is to present a formula for computing the pitch and lead of a worm, and leave it open for criticism. The result has been arrived at by comparison and observation. The point of comparison is the journal and bearing, where we have pressure and rubbing speed. For bearings it is agreed that the product of the pressure per square inch into the rubbing speed is a limiting constant. This principle is applied in this case to the worm-wheel tooth, and the limiting constants are obtained from observation. The difference between the case of a journal and that of a worm is in favor of the latter, and is due to the constant renewal of surfaces in contact. Consequently, a higher limiting constant is to be expected. Furthermore, as these qualities are not absolute but comparative, extreme accuracy is not essential.

We will consider the area of contact measured on the plane of the spiral as if of square cross-section, the resultant pressure normal to this area and the velocity of the rubbing surfaces, which is somewhat greater than the pitch-line velocity of the worm. The principle is then expressed thus:

$$\frac{P}{A} \times V = C \qquad (1)$$

FIG. 2. ASSUMED CROSS-SECTION OF WORM WHEEL.

in which

P = normal pressure.

A = area of contact.

$\frac{P}{A}$ = pressure per square inch.

V = rubbing speed in feet per minute.

C = limiting constant.

The resistance of the wheel tooth or load W, measured in pounds, produces a resultant normal to A equal to $W \cos. \alpha$, α being the angle of the thread, Fig. 1. The active force of the worm at the pitch line is $W \times \tan. \alpha \times \frac{1}{E}$, E being the efficiency of the thread, and equal to

$$\frac{\tan. \alpha}{\tan. (\alpha + \beta)},$$

β being the angle of friction. Substituting for E, the active force of the worm is $W \tan. (\alpha + \beta)$. The resultant of this force normal to A is $W \tan. (\alpha + \beta) \sin. \alpha$. The total resultant normal to A is the sum of the two:

$$P = W \left(\cos. \alpha + \tan. (\alpha + \beta) \sin. \alpha \right) \qquad (2)$$

Considering all wheels of 90 degrees cross-section, Fig. 2, the area of contact will be one-fourth the spiral length times the working depth of tooth, or

$$A = \frac{\frac{1}{4} \pi d}{\cos. \alpha} \times .6366\, p$$

$$= \frac{\frac{1}{2} p d}{\cos. \alpha} \text{ approximately,} \qquad (3)$$

in which d = pitch diameter of worm, p = pitch.

The area of contact, as here measured, is not absolutely correct, and consequently the pressure per square inch is more nominal than otherwise, but it comprises in itself all the elements that may alter it, and therefore is a true comparative figure.

It is strictly comparable with the so-called pressure per square inch on a bearing when we take for the area of contact the projected area of the bearing.

The velocity of the spiral or rubbing velocity, expressed as a function of the periphery speed of the wheel S is:

$$V = \frac{S}{\sin. \alpha} \qquad (4)$$

Substituting the values of P, A, and V, in formula (1) we have:

$$\frac{W \left(\cos. \alpha + \tan. (\alpha + \beta) \sin. \alpha \right) \times S \times \cos. \alpha}{\frac{1}{2} d p \sin. \alpha} = C$$

Making AO = pitch circumference of worm, and AE = the lead.

(The lead for single thread is equal to the pitch; for double thread is equal to twice the pitch, and so on.)

AOE = the angle of the thread.

EO = length of the spiral.

The same line represents the relative values of the pitch line velocity of worm AO, the periphery speed of the wheel at the pitch line AE, and the rubbing velocity or velocity of the spiral EO.

For a given angle α, the rubbing velocity in function of the periphery speed of the wheel is

$$AO = \frac{AE}{\sin. \alpha} \text{ or } V = \frac{S}{\sin. \alpha} \text{ formula (4).}$$

In the formula, V has been substituted by $\frac{S}{\sin. \alpha}$, in this way eliminating the speed of worm and using the speed of the wheel.

FIG. 3. DERIVATION OF FORMULA (4).

or,

$$W = d p \times \frac{\frac{1}{2} C}{S \cot. \alpha \left(\cos. \alpha + \tan. (\alpha + \beta) \sin. \alpha \right)}$$

The values proposed here for C are 80,000 for cast-iron, and 100,000 for hardened steel worms, consequently:

$$W = 4 \text{ or } 5 \times d \times p \times \frac{10{,}000}{S \cot. \alpha \left(\cos. \alpha + \tan. (\alpha + \beta) \sin. \alpha \right)}$$

or, $$W = 4 \text{ or } 5 \times d \times p \times f, \qquad (5)$$

f being a factor prepared in tabulated form herewith, and which is a function of S and α.

The table for values of f is given only as an example to illustrate its use. A more complete one may be necessary for constant use. The value

$$\left(\cos. \alpha + \tan. (\alpha + \beta) \sin. \alpha \right)$$

is almost equal to unity for small angles and may be neglected, but not so for larger angles.

In formula (5) for a given load W and

a given speed S, the value f changes with the angle; the value dp changes inversely as that of f. The increasing of dp means higher rubbing speed, or greater area of contact, or both. The decreasing of dp means lower rubbing speed, or smaller area of contact, or both. The values omitted in the lower part of the table are those which would give speed higher than 500 feet per minute. Those omitted in the upper part are those which would give a pressure per square inch of area of contact greater than 2,000 pounds.

In preparing a table of this kind these limits must be previously determined. The range here given is on the assumption that greater pressure is dangerous for safe working stress; and greater speed is not desirable for efficiency, though much higher speeds may be used. For a given diameter d and a given angle α the head is equal to $\pi d \tan. \alpha$. The value of $\pi \tan. \alpha$ will be found in the table under each angle, so that the lead when working a problem may be easily found.

$$w = 4 \text{ or } 5 \times d \times p \times f, \qquad f = \frac{10000}{S \cot \alpha \,(\cos \alpha + \tan (\alpha + \beta) \sin \alpha}$$

S	$\alpha°$ 2	3	5	7	10	13	16	19	22	25	30	35
10	34	52	87	121	173	224						
20		26	44	61	87	112	135	159	183	200	238	270
30			29	41	58	76	94	107	122	134	159	183
50				25	35	45	55	64	73	81	96	112
75					23	29	37	44	50	56	69	77
100						23	28	33	37	42	50	60
125							22	26	32	35	40	47
150								22	25	28	33	38
175									21	24	28	33
200										21	24	28
$\pi \times \tan \alpha°$	.11	.165	.275	.385	.554	.729	.901	1.08	1.27	1.46	1.82	2.2

w = safe load on worm wheel tooth, in pounds.
S = speed of worm wheel in feet per minute.
$\alpha°$ = angle of worm thread; β angle of friction.
f = factor, depending on the values $\alpha°$, S.
d = pitch dia. of worm; p = pitch in inches.
Lead = $d \times \pi \times tan.\ \alpha°$.
Factor "4" for cast iron, "5" for hard steel worms.

VALUES OF f.

In preparing a table of this kind these limits must be previously determined. The range here given is on the assumption that greater pressure is dangerous for safe working stress; and greater speed is not desirable for efficiency, though much higher speeds may be used. For a given diameter d and a given angle α the head is equal to $\pi d \tan. \alpha$. The value of $\pi \tan. \alpha$ will be found in the table under each angle, so that the lead when working a problem may be easily found.

As an example, let us suppose a boring-bar driven by a cast-iron worm and wheel; maximum load on the tooth to be 5000 pounds, at a minimum peripheral speed of wheel of 20 and a maximum of 150 feet per minute.

Following the 150-foot line of the table, the first value given (22) is under 19 degrees, and, similarly, following the 20-foot line the last figure (270) is under 35 degrees, and we conclude that angles between 19 and 35 degrees will answer. A smaller angle than 19 degrees would give a speed higher than 500 feet, while a larger angle than 35 degrees would give a heavier pressure than 2000 pounds per square inch and these, respectively, at the highest and lowest speeds set by the requirements of the problem.

Let us try with an angle of 19 degrees. For 20 feet $f = 159$, and substituting in formula (5):

$$5000 = 4\, d\, p \times 159$$

or,

$$d\, p = 8.$$

Trying different combinations we obtain:

p	d	lead
1 "	8 "	8.64"
1.3"	6.15"	6.64"
1.5"	5.33"	5.75"

From the latest combination we can get round figures as follows;

5½ diameter—1½ pitch—6" lead—(4 threads)—19° 9′ angle.

To prove this result we substitute these values in formula (5) giving:

$$W = 4 \times 5\tfrac{1}{2} \times 1\tfrac{1}{2} \times 160 = 5280 \text{ pounds},$$

which would be the safe working load at 20 feet wheel-speed. If we desire to still reduce the diameter of worm, we could do so by using a coarser angle.

As will be seen from the table, an angle of 19 degrees brings the result closer to the limit of speed than to that of pressure. A coarser angle would produce the opposite effect.

To find the safe load of the same wheel at its maximum required speed, 150 feet, we use the same formula, but the value of f is now equal to 22, giving:

$$W = 4 \times 5\tfrac{1}{2} \times 1\tfrac{1}{2} \times 22 = 726 \text{ pounds}.$$

Comparing the work done at maximum and minimum speed, we obtain:

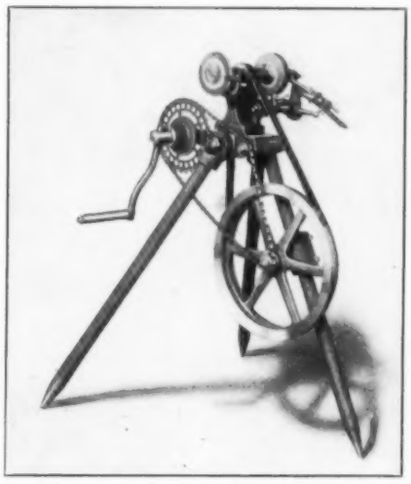
$$20 \times 5280 = 105{,}600 \text{ foot pounds},$$
$$150 \times 726 = 108{,}900 \quad " \quad "$$

which shows more efficiency at the higher speed.

For comparison let us find the safe load of a worm of the same diameter and pitch as before, but with 2 instead of 4 threads, using the same wheel speed, 20 feet. A worm of 5½ inches diameter, 1½ inches pitch, 3 inches lead, will give an angle of thread of 9 degrees 51 minutes. From the table, $f = 86$. Substituting: $W = 4 \times 5\tfrac{1}{2} \times 1\tfrac{1}{2} \times 86 = 2480$ pounds. And the same worm, single thread, other conditions remaining the same, would only show a safe load of 1450 pounds.

Hand-Power Drill Grinder.

The half-tone represents a machine for grinding twist drills by hand power. It consists of a special No. 2 Worcester drill grinder head, with a capacity of from 1/16 to 1 1/16-inch drills, mounted on a light tripod of steel-pointed pipe. The grinding spindle is driven from the belt wheel by one of Graton & Knight's special "Neptune" water-proof belts. This large pulley is driven in turn by a regular bicycle chain from the large sprocket above it. Experience has demonstrated that a laborer with the two-handed crank shown can easily keep up a speed of 1600 to 1700 revolutions per minute against the ordinary pressure of the drill on the grinding wheel. This machine was built at the Washburn shops of the Worcester Polytechnic Institute for the New York Central railroad for use in grinding drills where the electrification of the road is in progress. It was formerly the practice to send out each morning a large supply of freshly ground drills and as fast as they dulled to lay them one side to be ground when there was a large enough number to make it profitable to do so. With this machine it is expected that drills will be sharpened as fast as needed, the machine being picked up and carried along as the work progresses.



HAND-POWER DRILL GRINDER.

The Rowland Telegraph Co. of Baltimore, Md., will furnish the Postal Telegraph-Cable Co. one of the octoplex printing telegraphs invented by the late Prof. Henry W. Rowland, of Johns Hopkins University. Four messages can be sent over one wire in each direction simultaneously, each at the rate of 35 to 45 words a minute; the messages are recorded in print and are ready for delivery.

Letters to the Editor.

Welding Boiler Flues.

A few years ago I had occasion to visit a large manufacturing plant, and while being shown through by the superintendent I noticed a pile of about a thousand 3-inch boiler flues. Upon questioning the superintendent, he said they were played out, as the ends would not stand any more expanding, and their places were filled with new ones. When I asked why he did not have them welded, he said he had never thought of such a thing; in fact, did not know it could be done.

FIG. 1

FIG. 2

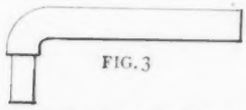


FIG. 3

WELDING BOILER FLUES.

While there I got him to order a dozen 3-inch flue stubs 7 inches long. I had one end of each of these beveled in the lathe as shown in Fig. 1. Then I had one end of a dozen played-out flues turned true and expanded as shown in Fig. 2; while hot I forced the beveled ends of the stubs into them. After heating evenly all around I welded them over the mandrel shown in Fig. 3. The flues were then cut to the required length, the bad or used end being cut off, of course. They were then pronounced as good as new.

The superintendent afterward wrote me that he had welded the thousand flues, and after figuring the cost he had saved one thousand dollars. G. E. M.

[While the welding of new ends on boiler tubes is not practised to any great extent with those of stationary boilers it is very common in railroad shops, and comparatively few locomotives are in service long before they have welded boiler tubes in them. Ed.].

Calculation of the Strength of a Crane Drum.

I have seen the method of finding the bearing reactions as described at page 519 used several times but have never been able to figure out the necessity of going to so much trouble. The following seems much simpler and more direct (Fig. 1):

W = load on drum, acting downward.
P = load on gear tooth, acting upward.
R_1 and R_2 = the bearing reactions.
D_1 = diam. drum.
D_2 = diam. gear, then

$$P = \frac{W \times D_1}{D_2}$$

$$R_1 = \frac{P \times l_4 - W \times l_2}{l_3}.$$

$$R_2 = \frac{P \times l_4 - W \times l_5}{l_3}.$$

From inspection it is easy to see the direction in which R_1 and R_2 act.

Example—See Fig. 2:

$$P = \frac{8000 \times 12}{20} = 4800$$

$$R_1 = \frac{4800 \times 35 - 8000 \times 20}{41} = +195,$$

acting downward.

$$R_2 = \frac{4800 \times 6 - 8000 \times 21}{41} = -3395,$$

acting upward.

DESIGNING THE DRUM SHAFT.

We must assume a length for the bearing. Say we call it 4½ inches, then a, Fig. 1 = 2¼ inches and we say that after the shaft is pressed into the drum the hub of the drum reinforces the shaft after we get in about an inch, consequently we may take the lever arm for the bending moment as 3¼ inches.

$$B = 3395 \times 3.25 = 11000.$$

$$B = S\frac{I}{c} = S\frac{\pi d^3}{32} = S\frac{d^3}{10.2}.$$

$$d = \sqrt[3]{\frac{B \times 10.2}{S}}.$$ Let S = 8000 lbs. per sq. inch.

$$d = \sqrt[3]{\frac{11000 \times 10.2}{8000}} = 2.41 = 2\tfrac{7}{16},$$ use 2½ inches.

A simpler method and one that saves figures is to assume a diameter and solve for S.

$$S = \frac{10.2\,B}{d^3} = \frac{10.2 \times 11000}{2.5^3} = 7200$$ lb. sq. inch. (Assuming that 2½ inches diameter will bring S below the allowable stress per square inch.)

DESIGNING THE DRUM.

The shell could not be made much less than ⅝ inch thick for mechanical reasons and for this size drum would hardly be considered. But as an illustration of the method, it will be applied to this case:

The drum is a large hollow shaft, carrying a load W and supported indirectly by the bearings. This load W produces a bending and also a twisting moment in the drum shell. The bending moment is $R_2 \times l_2$, and the twisting moment is $W \times \frac{D_1}{2}$.

$B = 3395 \times 20 = 67900.$
$T = 8000 \times 6 = 48000.$
Equivalent twisting moment

$$T_E = B + \sqrt{B^2 + T^2}$$

$$T_E = 67900 + \sqrt{67900^2 + 48000^2} =$$
$$67900 + 83000 = 150900.$$

Then solving for stress, using this moment, and the polar moment of inertia of a hollow circular section:

$$S = \frac{5.1 \times T_E \times D}{D^4 - d_4}$$

D = outside diam. drum shell.
d = inside diam. drum shell.

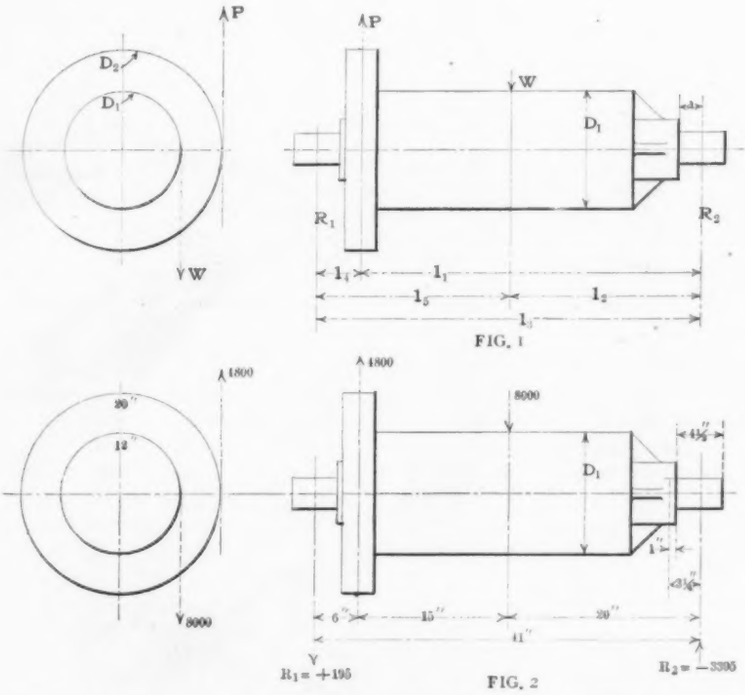


FIG. 1 FIG. 2

ELEVATIONS OF CRANE DRUMS, ILLUSTRATING CALCULATIONS IN THEIR DESIGN.

$$S = \frac{5.1 \times 150900 \times 12}{12^4 - 10.75^4} =$$
$$920000 \div 7436 = 124$$ lbs. per sq. inch.

Another thing that must be considered is the journal pressure per square inch.

Let P = Load on journal.
D = Diameter journal.
L = Length journal.
p = Pressure per square inch which ought not to exceed 500 lb. in

this class of machinery although it does sometimes run higher.

$$p = \frac{P}{D \times L} = \frac{3395}{2\frac{1}{2} \times 4\frac{1}{2}} \quad 302 \text{ lb. per sq. inch.}$$

As R_1 is much smaller than R_2 we might have a smaller journal for R_1, but this is seldom done for this reason alone, unless it is very large. G. A. R.

Milling the Gap in Packing Rings.

Having read various articles on the manufacture of piston and valve packing rings in the columns of the AMERICAN MACHINIST, I noticed that very little had been said about milling them to obtain the spring. I therefore send sketches and a brief description of several methods employed by us. Fig. 1 shows a view of the fixture used in milling the lap ring. As we manufacture this style ring in large quantities, this fixture was designed to mill four rings at one time. *A* is the body of the fixture, which consists simply of a cast-iron plate, tongued into the platen of the milling machine. Fixed pins *B* locate the rings central with the cutters. The removable pins *C* are used with the second cut, enabling the operator to obtain accurate results, without extraordinary skill. The removable pins are the same diameter as the width of the cut, and thus serve as gages to set the cutter *E*. Care is taken to set the inner edge of the cutters exactly in line with outer edge of the removable pins, as per dotted lines in the sketch. After the cutters are set by the pins *C* the pins are removed, as they are not required again until the rings are all milled on one side. Then the pins are replaced, and the rings are milled on the opposite side, the slot in first side being placed over the removable pins, which with the stationary pins bring the work into proper position. Special straps *D* hold the work while being milled. Fig. 2 shows another view of the rings after they are milled, and the straps removed. The removable pins *C* are shown in position, the head of the pin filling the slot in width, but only reaching half of the hight, to allow the ring to fit over. *C D E F* represent the finished ring open and sprung together. One little drawback which as yet we have never overcome, is the little opening shown at *F*, caused by springing the ring together. The only remedy for this is the file. Perhaps some of the readers might suggest some way around this, and obviate the necessity for any vise work.

Another type of ring which we make in large quantities is the ordinary split ring. In milling this ring we use an ordinary angle iron, set at the proper angle to give the slanting cut. We use the permanent pins to locate the rings the same as in the other fixture. The angle iron *A*, Fig. 3, is slotted to allow the cutter to pass through, as is also the strap *C*. The cutter is ground slightly tapering, thus milling a cut wider at the top than at the bottom, allowing the ring to be sprung together, making a perfect joint. In this ring we get the desired result, namely a ring requiring no vise work. *A*, Fig. 4, shows a ring milled with a straight cutter, which leaves an opening when sprung together. The ring marked *B* was milled by a slightly tapering cutter, which allows the ring to be sprung together, leaving no gap.

A freak ring, which was to have been a world-beater, but failed, consisted of an ordinary lap ring, with the slots milled deep enough to leave an opening about one eighth of an inch wide. This opening was filled with a T-shaped piece of brass which fitted under the ring, just filling the opening. The freakest part of this ring lay in a number of small holes drilled through the piston head and coming out beneath the ring. The idea was that the steam was to come underneath the rings and force them out. This would have been a success, if the steam pressure did not vary in the length of the cylinder, and thus wear the cylinder more at each end than the center. TEXAS.

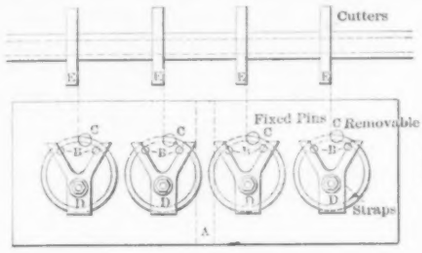


FIG. 1

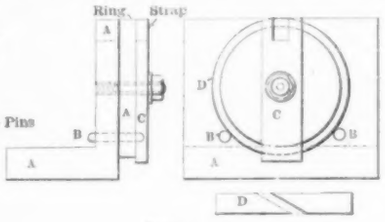


FIG. 3

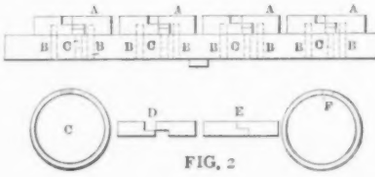


FIG. 2

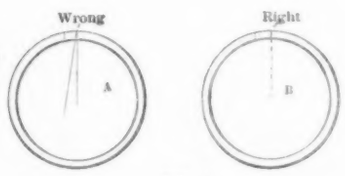


FIG. 4

MILLING THE GAP IN PACKING RINGS.

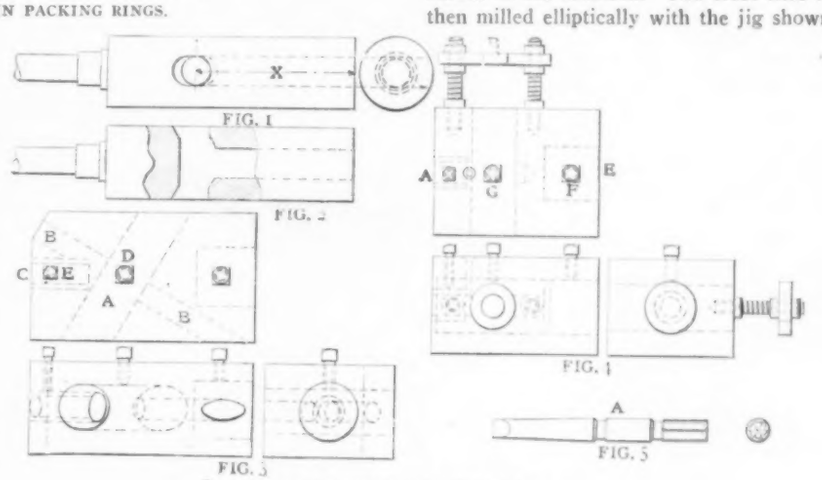
End Milling and Drilling in the Lathe.

Figs. 1 and 2 show a piece of work which we make in large quantities. There is nothing out of the ordinary about it except the holes, but the manner of producing them may be of interest.

To produce these holes, jigs of course are necessary, and as the only machines available were the lathes the jigs were made for use in them.

Figs. 3 and 4 show the jigs for drilling and milling the cross hole. The end mill is shown at Fig. 5.

The cross hole is drilled first, using an ordinary twist drill in the jig Fig. 4. The longitudinal hole is then drilled by holding the work in the chuck with the outer end in the steady rest, the drill being held in a holder in the tailstock. The cross hole is then milled elliptically with the jig shown at Fig. 3. The drilling jig, Fig. 4, for the cross hole, is of soft steel with a drill bushing of tool steel hardened and ground. As the size of the hole and the dimension *X* varied with different orders it was necessary to have some adjustment. A change in the size of the hole simply requires another size drill and another bushing to fit at *A*. For changing the distance of the hole from the end—dimension X—the stop *B* is adjusted in or out by the nuts. The hole *E* fits the tail spindle and is held by the screw *F*. The screws *F* and *G*, have inserted in the end a piece of copper so that when tightened the work or



THE WORK AND THE JIGS.

spindle will not be marred. The milling jig Fig. 3 is of the same type as the drill jig but provided with a different means of locating the work. The hole *A* and the hole *B* are at right angles to each other, the hole *B* being the same size as the cross hole in the work.

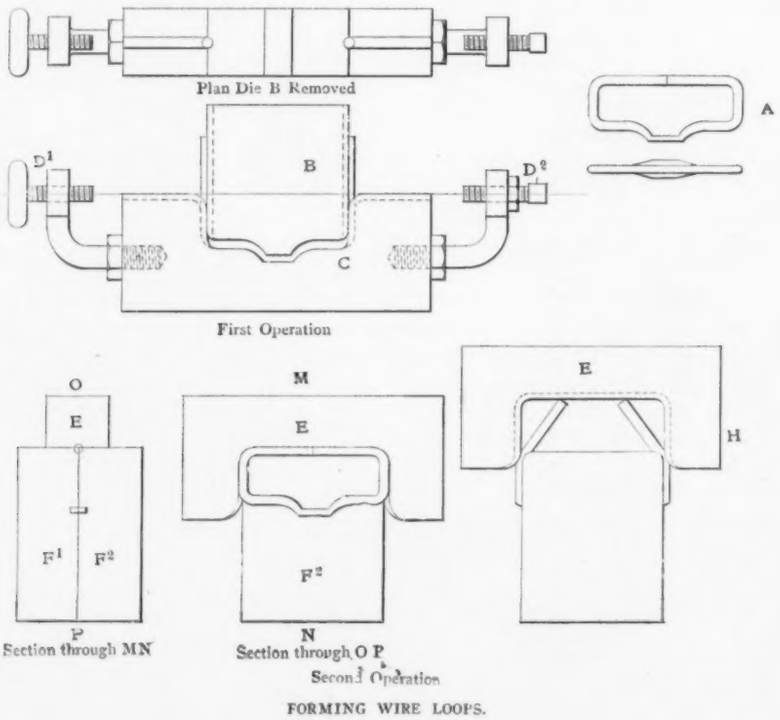
Only one side of the cross hole is milled at a time so it is necessary to have a means of locating the hole; *B* serves to locate and index the work at the same time. In operation the bushing *C* is knocked out and the work is pushed into the hole *A*. A hardened pin is then driven into the hole *B* and through the cross hole in the work; the screw *D* is then tightened onto the work; the pin is driven out; bushing *C* slipped back in place and fastened by the screw *E*. The jig is then all ready for milling. The end mill is held in a holder in the spindle. To mill the other side of the hole the piece is taken out and turned over. Plenty of oil is used during drilling and milling. The straight part *A* on the end mill is a running fit in the bushing and acts as a support.

PAUL WESLEY.

Forming Wire Loops.

An order came in the other day for some wire loops, as shown at *A*, which we made as follows: I made two pairs of dies as shown, the die *C* being grooved on top and sides, it carried the stops D^1 and D^2. The top die was grooved up the sides so that when in place a piece of the wire to be used would enter easily. Having the wires cut the correct length the stops are set equidistant from the center of the die. All the corners must be well rounded and polished to allow the wire to draw down without marking. The finishing dies are *E* and the pair F^1 and F^2 which hold the wire in position while the die *E* descends as at *H*. The dies F^1 and F^2, are held together by mechanism on the press which releases when the die *E* ascends, so that they can be opened to allow the finished article to be withdrawn.

England. YOUNG UN.

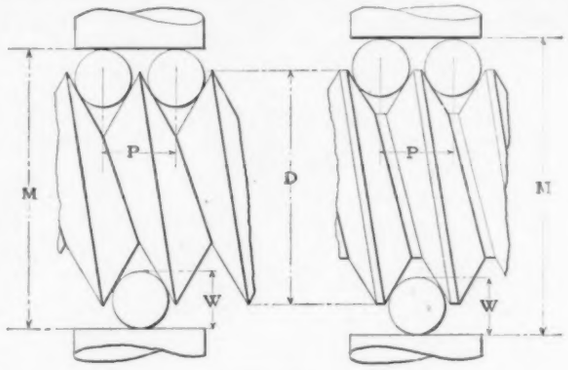


FORMING WIRE LOOPS.

Measuring Screw Thread Diameters.

At page 904, vol. 26, Walter Cantelo illustrated a method of measuring screw threads by using wires in the thread angles and measuring across with the micrometer; and in his article were included tables of constants for facilitating matters.

TH'DS PER INCH	FOR V TH'D 1.732 P=	FOR SELLERS TH'D 1.5155 P=
8	.21650	.18943
9	.19244	.16839
10	.17320	.15155
11	.15745	.13777
12	.14433	.12629
13	.13323	.11658
14	.12371	.10825
16	.10825	.09472
18	.09622	.08419
20	.08660	.07578
22	.07872	.06889
24	.07216	.06314
26	.06928	.06062
28	.06185	.05412
32	.05412	.04736
36	.04811	.04210
40	.04330	.03789
48	.03608	.03157
50	.03464	.03031
56	.03093	.02706
64	.02706	.02368
80	.02165	.01894
100	.01732	.01516



FORMULAS.

FOR V THREAD
D=M−3 W+1.732 P.
M=D−1.732 P.+3 W

FOR SELLERS THREAD
D=M−3 W+1.5155 P.
M=D−1.5155 P.+3 W.

D=Diameter of Screw
M=Measurement over Wires
W=Diameter of Wires
P=Pitch

CONSTANTS FOR USE WITH THE 3-WIRE SYSTEM OF MEASURING SCREW THREADS.

The accompanying table should be of service to those using the three-wire system of measurement as the constants cover the finer pitches and may be easily applied to screw threads of any diameter. The diagrams make the method of application so plain that no description appears necessary.

JAS. DANGERFIELD.

Roll Grinding.

Referring to C. H. Norton's article on roll grinding at page 563, I cannot quite agree with him in this matter. Although Mr. Norton is an authority on grinding, I do not see how he can produce true and accurate rolls by grinding them on their centers.

I take it from his article rolls can be ground on two dead centers true and concentric regardless of weight. Why grind on such small bearings when you have true journals? Assuming we have a roll weighing 500 lb. in the grinding machine requiring some time to finish, would two small center holes support this weight when rotating, and remain true? If the journals are true before grinding the body, will they remain so until the operation is completed?

Mr. Norton tells us the journals wear out of round, but says nothing about the center holes wearing. If the journals are not round, lap the center holes if necessary, touch up the journals and place the roll on its own journals and grind the body. With this method of procedure there is not the least chance for any inaccuracy to occur if the journals are ground round, which can be done with properly made center holes. Before placing the roll in the housings the boxes should be scraped to fit the journals, although the diameter is slightly decreased, more wear will be secured by good fitting boxes.

J. H. HOLLINGER.

Metric Screw Threads—Rounding Threads at the Bottom.

At page 549, O. Bickford urges as an objection to screw threads rounded at the bottom, that the removal of the extra stock to provide for the round, weakens the piece. I do not think that this is certain, and am inclined to think that the gain due to avoiding sharp corners more than compensates for the removal of the stock required to give a round corner.

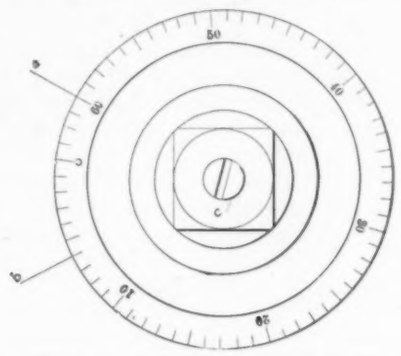
The matter could be very easily investigated in the testing laboratory of one of our colleges. Two round bars should be prepared each with a circular groove having the proportions and profile of a U. S. standard thread. Then the groove in one should be rounded at the bottom, being deepened necessarily. I believe the latter bar would prove as strong if not stronger than the one with sharp corners and greater minimum area.

SANFORD A. MOSS.

Cutting Racks on the Milling Machine.

A job came in one day that called for the cutting of a rack ratchet a little over six inches long, and with 32 teeth per inch. The most natural way to do this job was to hold the blank in the milling machine vise and space the teeth by means of the dial on the crossfeed screw, moving 0.03125-inch each time. But this is an awkward move to handle, and as it would have to be repeated about 200 times in the length of rack I had to cut, and that quarter-thousandth might mix me up, I thought of making a special dial for this particular job, and thus lessen the liability of making mistakes. As the crossfeed screw had 5 threads per inch, I might have made a dial with 32 divisions and moved 5 of these each time, but instead of this I graduated a dial in 64 equal parts and then moved 10 divisions each time, to get a movement of the race blank of 1/32 inch. As 10 exact divisions were moved each time, it was a comparatively easy job to keep track of them, and not "lose the place." The dial was set to read 0 for the first cut, and subsequent readings were 10, 20, 30, 40, 50, 60; 6, 16, 26, 36, 46, 56; 2, 12, 22, 32, etc. In the sketch, *a* is the regular line scratched on the knee to read against, and *b* is a pencil or chalk mark put on for the job in hand, 10 divisions away from *a*, and serving to indicate the division on the dial that is next to be brought to tally with *a*. The chalk mark *b* is not a necessary feature to be used with the special dial shown, but it serves as a check on the counting, and can often be used to advantage with the dial regularly furnished by the makers.

The milling machine on which I did this job had the dial held in place by a small pin forced out radially by the taper-pointed screw *c*, so as to engage in a recess turned in the bore of the dial, but this pin was so gummed up with oil that it failed to drop when screw *c* was removed. By applying the mouth to the squared end of the screw and producing a partial vacuum with the lungs, the little pin was quickly pulled into its hole and the dial then taken off. When the new dial was put in place, a slight amount of wind pressure forced the little pin out again.



SPECIAL DIAL FOR MILLING MACHINE.

Pitch of rack	8	9	10	11	12	14
Movement of cross feed dial	$1\frac{53}{55}$	$1\frac{41}{55}$	$1\frac{32}{56}$	$1\frac{21}{56}$	$1\frac{17}{55}$	$1\frac{5}{41}$
Error on circular Pitch	.00008 c	.00002 c	.00012 c	.00011 c	.00002 c	.00001 f
Pitch of rack	16	18	20	22	24	26
Movement of cross feed dial	$\frac{54}{55}$	$\frac{48}{55}$	$\frac{44}{56}$	$\frac{40}{56}$	$\frac{36}{55}$	$\frac{46}{76}$
Error on circular Pitch	.00001 c	.00002 c	.00006 c	.00006 c	.00001 c	.00023 c
Pitch of rack	26	30	32	36	40	48
Movement of cross feed dial	$\frac{23}{41}$	$\frac{22}{42}$	$\frac{27}{55}$	$\frac{24}{55}$	$\frac{22}{56}$	$\frac{18}{55}$
Error on circular Pitch	.00000	.00004 c	.00001 c	.00001 c	.00003 c	.00000

TABLE FOR USE IN CUTTING RACKS ON THE MILLER.

Having found how useful a special dial was when applied to the job mentioned, it occurred to me it might be advantageous to employ something of the sort when cutting diametral pitch racks, and with this object in view I computed the table herewith, which shows that a dial with 55 divisions is an extremely useful one to have on hand in a small job shop, as it enables us to cut racks of 8, 9, 12, 16, 18, 24, 32, 36 and 48 pitch with a degree of accuracy well within practical limits. Another useful dial is one with 56 spaces, as that will enable us to cut racks of 10, 11, 20, 22 and 40 pitch with very small errors of spacing. With a dial with 41 equal parts we can cut racks of 14 and 28 pitch practically accurate, and with a dial of 42 parts we can cut 30 pitch racks. Also a 76 dial will cut 26 pitch racks accurate enough for nearly every purpose.

All these special dials have coarser or more open divisions than the regular dial furnished with the machine, and are, in that respect, much easier to read. The letters *c* and *f* after the tabulated errors indicate whether the pitch produced by that particular move is coarser or finer than it should be.

WALTER GRIBBEN.

Split Dies—Holding Dies.

At page 423, J. L. Lucas inquires as to different ways of holding split dies in the bolster. I enclose a sketch of one way of holding them where one bolster is used for a lot of dies. In Fig. 1, a wedge is shown instead of screws to tighten the dies, the objection to screws being that the ends get chipped, and if used in this way often cause the dies to shift out of place while being used. Also the heads get broken off if given too hard a twist with the wrench, which means a lot of trouble in getting them out, often dam-

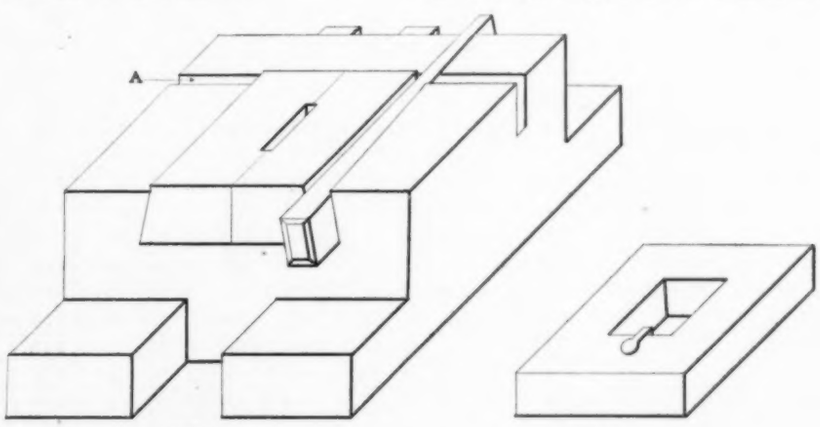


FIG. 1 FIG. 2

SPLIT DIES—HOLDING DIES.

aging the bolster and dies also. Referring again to Fig. 1, the face *A* is made square with the inside face of the bolster, which the dies fit against; the taper is on the opposite side The dies are pushed against face *A* and the wedge driven lightly in. If the dies do not come together properly, screws at the end of the bolster are brought into use till the punch fits into the dies. The wedge is then driven home with a mallet. Several wedges of different thicknesses are kept to compensate for any variation in the width of the dies.

Mr. Lucas also shows a sketch of a split die with a projecting piece, stating it would be much easier to repair this, than to make a whole new die. Fig. 2 shows a way out of this difficulty. The hole is drilled three-quarters of the way through the die, slotted, and the piece fitted in. This stands much better than making the whole die solid, with the advantage that it can be replaced without softening the die. A. J. W.

Beeston, England.

Block Indexing on the Brown & Sharpe Gear Cutter.

In the treatise on gear cutting published by the Brown & Sharpe Company the subject of block indexing is touched upon in a manner which is far too casual in my opinion, for so important an operation.

By block indexing I don't mean cutting in blocks by means of a multiple cutter, but cutting a tooth here and there, skipping some in between.

I have mentioned this system to a few of my friends who are interested in gear cutting, and their ignorance of it has led me to think that perhaps a lot of the readers of the AMERICAN MACHINIST may not be familiar with this method of indexing.

In England it is usual to supply with lathes 22 change-gears rising from 20 teeth to 120 by fives, with an extra forty or sixty wheel, so that anyone manufacturing lathes has the most gear cutting in connection with the change wheels.

It was the necessity for cutting twelve sets, 264 gears in all, of eight-pitch change gears that stirred me up to try and increase our output. We had previously run about six inches a minute on this work and even at this the cutter and work got fairly warm.

However, we ran the risk of overheating and gradually increased the feed to 0.2 inch per revolution, the cutting speed being forty feet a minute. At these speeds the work and cutter got uncomfortably hot and the cutter required sharpening after cutting half way around the 120 tooth gears of which we put six on the arbor at once.

Then the idea of indexing seven teeth instead of one and letting the machine go round a few more times was tried and proved a revelation to all of us. We can now cut six gears 1¼ inches face, with 120 teeth at the rate of eight inches a minute with one sharpening of the cutter, and both the blanks and the cutter are practically as cool when they have done this as when they started.

Of course indexing seven teeth would not do in every case; in fact, only when the number of teeth to be cut is not an exact multiple of seven, ought it to be used.

The table gives the necessary change gears to use, on Brown & Sharpe machines only, which I think will cover all ordinary requirements and which I hope will prove of use to those who use gear cutters but have never previously tried this method.

England. G. EAR.

Gas Engine Powering.

Under the above title Sanford A. Moss gives at page 381 a formula to determine the diameter of a four-cycle gas-engine cylinder, which reads:

Teeth to be Cut	No. Indexed at Once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc	Teeth to be Cut	No. Indexed at Once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc	Teeth to be Cut	No. Indexed at Once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc	Teeth to be Cut	No. Indexed at Once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc	Teeth to be Cut	No. Indexed at Once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc
25	4	100	50	72	30	4	**52**	5	100	30	90	52	2	**86**	5	100	30	90	86	2	**123**	7	100	30	84	82	2	**161**	5	100	70	60	46	2
26	3	100	50	90	52	4	**54**	5	100	30	90	54	2	**87**	7	100	30	84	58	2	**124**	5	100	60	90	62	2	**162**	7	100	60	84	52	2
27	2	100	50	60	54	4	**55**	4	100	50	96	44	2	**88**	5	100	30	90	88	2	**125**	7	100	50	84	50	2	**164**	5	100	60	90	82	2
28	3	100	50	90	56	4	**56**	5	100	30	90	56	2	**90**	7	100	30	70	50	2	**126**	5	100	50	50	42	2	**165**	7	100	50	84	66	2
29	3	100	50	90	58	4	**57**	4	100	30	96	76	2	**91**	3	100	70	72	52	2	**128**	5	100	60	90	64	2	**168**	5	100	60	90	84	2
30	1	100	50	60	60	2	**58**	5	100	30	90	58	2	**92**	5	100	30	90	92	2	**129**	7	100	30	84	86	2	**169**	6	96	52	90	78	2
31	3	100	50	90	62	4	**60**	7	100	30	84	40	2	**93**	7	100	30	84	62	2	**130**	7	100	50	84	52	2	**170**	7	100	50	84	68	2
32	3	100	50	90	64	4	**62**	5	100	30	90	62	2	**94**	5	100	30	90	94	2	**132**	5	100	88	80	40	2	**171**	5	70	42	80	76	2
33	4	100	50	80	44	4	**63**	5	100	30	80	56	2	**95**	4	100	50	96	76	2	**133**	4	100	70	96	76	2	**172**	5	100	60	90	86	2
34	3	100	50	90	68	4	**64**	5	100	30	90	64	2	**96**	5	100	30	90	96	2	**134**	5	100	60	90	67	2	**174**	7	100	60	84	58	2
35	4	100	50	96	56	4	**65**	4	100	50	96	52	2	**98**	5	100	30	90	98	2	**135**	7	100	50	84	54	2	**175**	8	100	50	96	70	2
36	5	100	48	80	40	4	**66**	5	100	44	80	40	2	**99**	10	100	30	80	44	2	**136**	5	100	60	90	68	2	**176**	5	100	60	90	88	2
37	5	100	30	90	74	4	**67**	5	100	30	90	67	2	**100**	7	100	50	84	40	2	**138**	5	100	92	80	40	2	**180**	7	100	60	70	50	2
38	5	100	30	90	76	4	**68**	5	100	30	90	68	2	**102**	5	100	30	60	68	2	**140**	3	50	50	90	70	2	**182**	9	90	56	96	52	2
39	5	100	30	90	78	4	**69**	5	100	46	80	40	2	**104**	5	100	60	90	52	2	**141**	5	100	94	80	40	2	**184**	5	100	60	90	92	2
40	3	100	50	90	80	4	**70**	3	100	50	90	70	2	**105**	4	100	70	96	60	2	**143**	6	90	66	96	52	2	**185**	6	100	50	72	74	2
41	5	100	30	90	82	4	**72**	5	100	30	90	72	2	**108**	7	100	30	70	60	2	**144**	5	100	60	90	72	2	**186**	7	100	60	84	62	2
42	5	100	30	90	84	4	**74**	5	100	30	90	74	2	**110**	7	100	50	84	44	2	**145**	6	100	50	72	58	2	**187**	5	100	44	48	68	2
43	5	100	30	90	86	4	**75**	7	100	30	84	50	2	**111**	5	100	74	80	40	2	**147**	5	100	98	80	40	2	**188**	5	100	60	90	94	2
44	5	100	30	90	88	4	**76**	5	100	30	90	76	2	**112**	5	100	60	90	56	2	**148**	5	100	60	90	74	2	**189**	5	100	60	80	84	2
45	7	100	50	70	30	4	**77**	4	100	70	96	44	2	**114**	7	100	30	84	76	2	**150**	7	100	60	84	50	2	**190**	7	100	50	84	76	2
46	5	100	30	90	92	4	**78**	5	100	30	90	78	2	**115**	8	100	50	96	46	2	**152**	5	100	60	90	76	2	**192**	5	100	60	90	96	2
47	5	100	30	90	94	4	**80**	3	100	50	90	80	2	**116**	5	100	60	90	58	2	**153**	5	100	68	80	60	2	**195**	7	100	50	84	78	2
48	5	100	30	90	96	4	**81**	7	100	30	84	52	2	**117**	8	100	30	96	78	2	**154**	5	100	56	72	66	2	**196**	5	100	60	90	98	2
49	5	100	30	90	98	4	**82**	5	100	30	90	82	2	**119**	3	100	70	72	68	2	**155**	6	100	50	72	62	2	**198**	7	100	50	70	66	2
50	7	100	50	84	40	4	**84**	5	100	30	90	84	2	**120**	7	100	50	70	40	2	**156**	5	100	60	90	78	2	**200**	7	60	60	84	40	2
51	4	100	30	96	68	2	**85**	4	100	50	96	68	2	**121**	4	60	66	96	44	2	**160**	7	100	50	84	64	2							

INDEX TABLE FOR SPACING IN BLOCKS ON THE BROWN AND SHARPE GEAR CUTTER.

$$d = 35.5 \sqrt{\frac{I.H.P.}{M.E.P.\sqrt{l}}}$$

This equation must be solved by trial and error, a guess being made at the value of l. Some time ago I had to design a 75 horse-power engine, and I arrived at a similar formula, which to me was not as *trying*. I have written it in my note book:

$$d \quad 16.031 \left(\frac{H.P.}{P}\right)$$

but it would be better understood, perhaps, if put in the form:

$$d = 16.031 \sqrt[5]{\left(\frac{H.P.}{P}\right)^2}$$

where $H.P.$ = indicated horse-power and P = mean effective pressure.

The value of d being known,

$$l = 1.5\, d.$$

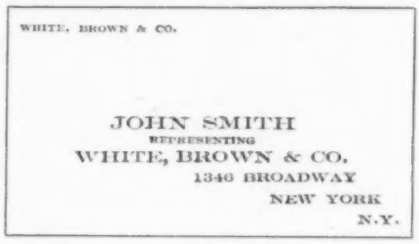
J. A. G. GOULET.

Standard Business Cards—Preserving Advertising Matter.

The articles at pages 260 and 353, by W. Osborne and Herman Jonson respectively, regarding business cards prompt me to add my mite on the subject. In regard to standard 3x5 cards for business purposes, I wish to make the following suggestions: Print one side of the card as in Fig. 1, the firm name in the upper left-hand corner in small bold-face type serving as an index to the address of that firm when sought for in the card catalog. Print the other side of the card as in Fig. 2, the leading article of sale or manufacture being printed in the upper left-hand corner in the bold-face type as an index, with the firm's name underneath followed by other articles of sale or manufacture. In the right-hand upper corner, place the number or index of the firm's catalog so that the card will also serve as an index card to their catalog in case it is desired to look it up for more detailed information regarding the subject sought. If desired some or all of the other articles of sale or manufacture can be used on separate cards as indexes in the upper left-hand corner so that with a complete set of these cards a firm's goods would be thoroughly indexed in the buyer's card catalog, which would be of great advantage to the purchasing agent. The names of the various articles could be so arranged on the card as to allow space for quotations with a space for date of quotation arranged in the left-hand lower corner.

Many of the trade catalogs issued today are really works of art, the cost of publication being so great as to prohibit their promiscuous distribution among the trades; yet in order to comply with the request of a small purchaser of perhaps only one article who wishes to see a cut and description of it before placing his order it is necessary either to send him a copy of the complete catalog; multilate a catalog by sending him the page or pages on which the desired article is shown or issue a circular or "flyer" describing the article. These circulars, of all shapes and sizes, are frequently consigned to the waste basket after perusal, and sometimes before, because of a lack of any system to file such miscellaneous sizes and shapes.

Instead of issuing these circulars, etc., why not print a good illustration of the


WHITE, BROWN & CO.

JOHN SMITH
REPRESENTING
WHITE, BROWN & CO.
1346 BROADWAY
NEW YORK
N.Y.

FIG. 1. FACE OF CARD.

article under consideration on one side of a standard card together with such data as there is room for, placing the title in the left-hand upper corner as an index, with the manufacturer's name located where it will not interfere with the subject matter, using the reverse side of the card for additional data or descriptive matter if necessary? Then when a request comes in for price and description of certain articles the cards pertaining to those articles can be mailed at slight expense.

The line of manufacture of many concerns is such that every article could be clearly shown on one of the standard cards together with the prices and necessary data, and many others could make their cuts, etc., conform to the required size if they started out with this object in view.

The 3x5 card is the size most used in card catalogs, then come the 4x6 and the 5x8 cards. If a person will cut a piece of celluloid or tracing cloth to the smallest and intermediate sizes of cards and place them over engravings and descriptive matter in various trade catalogs and circulars, he will be surprised to find how

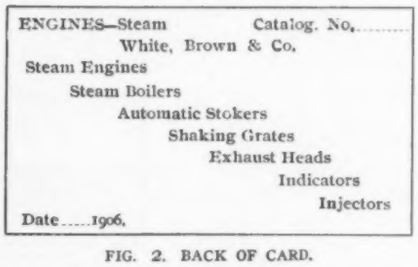

ENGINES—Steam Catalog. No.....
White, Brown & Co.
Steam Engines
Steam Boilers
Automatic Stokers
Shaking Grates
Exhaust Heads
Indicators
Injectors
Date.....1906.

FIG. 2. BACK OF CARD.

much matter could be placed on these two cards without any change in set-up even, by merely printing the matter on the cards, instead of on the catalog pages, and much other matter would go on the cards by a little rearrangement.

In order to make the matter on 3x5 cards available for use by the person whose card catalog is made up of 4x6, or 5x8 cards, the following method could be adopted:

Set the matter up as though it were to be printed on a 3x5 card, but print it in the left-hand upper section of 5x8 cards with dotted borders printed to divide the card into sections 3x5 and 4x6 inches. Then a person receiving one of these cards files it as it is if his catalog system is made up of 5x8 cards, but if made of 4x6 or 3x5 cards he cuts the card on the border line corresponding to the size of cards used in his catalog. There is a patented card on the market which possesses this feature by having perforations instead of the printed borders so that the card is made the required size by tearing along the perforated lines instead of cutting.

The card catalog can be used to good advantage in preserving and cataloging advertisements, etc., containing engravings and descriptive matter. With the present state of the art of engraving one gets almost as good an idea of an object from seeing an illustration of it as he would by seeing the object itself, and the descriptions are of necessity clear and condensed. In many cases a new machine or article makes its first appearance in print through the medium of an advertisement.

A good way to prepare such clippings for the card catalog is to use a piece of transparent celluloid 1/16 in. less in length and width than the cards used, so that the clipping when moist will not project beyond the edges of the card, place the celluloid over the engraving or printed matter so as to get the desired position and then mark lightly around its edges, afterward clipping to these lines and pasting the clipping onto the cards, putting the proper index letters in the left-hand upper corner with pen or pencil. By placing the cards between blotters with weights on them, they will dry flat and remain so.

To many readers the above may seem like "threshing old straw", for some concerns have adopted similar methods in issuing some of their trade literature, but they are few in number, and this is written in the hope that it may influence others to do likewise. M. H. G.

Sharpening Lawn Mowers.

As the grass is beginning to grow to a length which causes us to hunt around the shed or the cellar for the lawn mower, I wish to say to all readers of the AMERICAN MACHINIST—who have not had the honor of dissecting one or more of these machines, and who do not care to pay the usual fifty cents for getting it sharpened—that if they remove the wheels take the left or right hand driving pinion and change it to the opposite side with the pawl properly in place the knives will be found to revolve backward upon turning the wheel. A little emery and oil, a couple of twists of a screw-driver to adjust the stationary blade, and ten to twenty minutes' hand turning with anything in the form of a handle fastened to the wheel will usually sharpen a mower

whose blades are not excessively blunt. Of course a foot power of any kind where the belt could be run over the wheel will increase the efficiency several hundred per cent. W. L. McL.

Canada.

Keeping Track of Press Tools.

At page 423, J. L. Lucas gives a brief description of his system for keeping track of press tools.

I have experienced the same trouble as Mr. Lucas, in having to run all about the

CUPBOARD No. 2

No.	Description	Shelf	No.	Description	Shelf
90			120		
91			121		
92			122		
93			123		
94			124		
95			125		
96			126		
97			127		
98			128		
99			129		
100			130		
101			131		
102			132		
103			133		
104			134		

FIG. 1. THE INDEX SHEET.

shop to find certain tools, and have known times when three or four men have been searching for a tool, and after spending several fruitless hours, another one has had to be made to replace it.

These searches became so frequent that I found it necessary to adopt a system for keeping track.

Below is a description of the system I used, which worked very successfully, and I hope it will prove equally successful to those who care to adopt it.

I found that the cupboards already used for keeping the tools would serve the purpose very well. These were about 2 feet from front to back, 4 feet 6 inches wide, and contained 4 shelves 9 inches apart. Each cupboard held about 60 or 70 pairs of tools. All blanking tools were usually kept at the front, and tools for successive operations behind them, leaving at the same time plenty of room for getting any of them out without disturbing the others. The tools were then marked each with a distinctly different number (I note Mr. Lucas marks his tools thus, A.1. A.2. A.3. and so on. I have tried this method of marking but find it rather confusing, so I marked the tools with numbers only). I not only marked the punch and die, but also each part connected with them (including the screws) so that in the event of any tools being taken to pieces, it would be an easy matter to find the dies to which the parts belong.

Having numbered all the tools in this manner, I then made an index sheet, as shown at Fig. 1, from which I took blueprints for each cupboard, giving the description and numbers of the tools therein. These were then fixed inside their respective cupboards, as at Fig. 2, but having about 30 of these cupboards I found difficulty in knowing just where to lay my hands on any particular tool without journeying from one cupboard to another. To avoid this I used another set of sheets exactly the same as those previously fixed in the cupboards. I then got the carpenter to make some frames to take these sheets and to fix them over the cupboards as shown at Fig. 2, leaving a fair amount of room underneath for hooks. These hooks were numbered exactly the same as the numbers on the sheets above them. A youth was then put in charge of the tools, his duty being to give the tools out as required, and to see that they were in good working order before placing them in the cupboards again, thus having them always ready for immediate use.

All toolmakers, repairers and setters were supplied with a dozen checks each, on which were stamped their respective numbers. Now suppose Charlie, the toolsetter, requires a tool; he goes to Harry, the youth in charge, and says, "I want the tools for the second operation for s. s. steel drops." Then Harry, before going to the cupboards, looks down the index sheets placed above them, and if he finds a check on the hook of the same number as the tool required, he is then assured that the tool is out, and a glance at the number on the check will tell him who is in possession of the tool; but on the other hand, should the tool be in its place in the cupboard, he gives it to Charlie and receives in return one of his (Charlie's) tool checks, which he places on the hook of the same number as the tool given out; thus the whereabouts of any tool can easily be ascertained.

England. W. G. JOPSON.

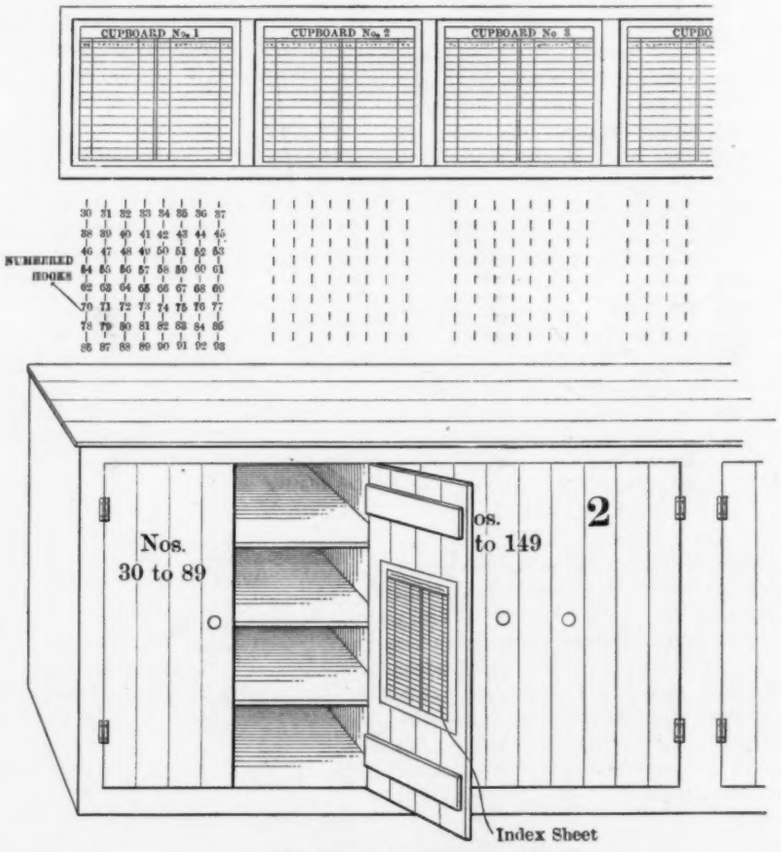


FIG. 2. THE CUPBOARDS.

Religious Services in a Machine Shop.

Happening to be in a large Canadian city some time ago, I was much interested upon being told that there was a machine shop where religious services were held every morning from 7 o'clock till about 7:30, or sometimes even longer. Being somewhat skeptical on the subject, I decided to see this phenomenon myself before accepting what I was told as the "unabridged." I got down to the shop at 6:55 the next morning, and after being assured that there were no objections to visitors, I entered and took a seat in a fairly large room, with raised platform, having a sort of pulpit and an organ. Small "Glory" song books were provided in racks on the backs of each chair.

Exactly at one minute past seven the owner of the shop arose and read a short portion of the scriptures, then offered a prayer, and a hymn was given out. After singing it (the singing surprised me as nearly everyone joined in heartily) a young man whom I judged to be a clergyman gave us a 20-minute talk. Another hymn finished the services at 7:35, and the men filed out.

I counted 47 that morning (they employ between 100 and 150 men) and was in-

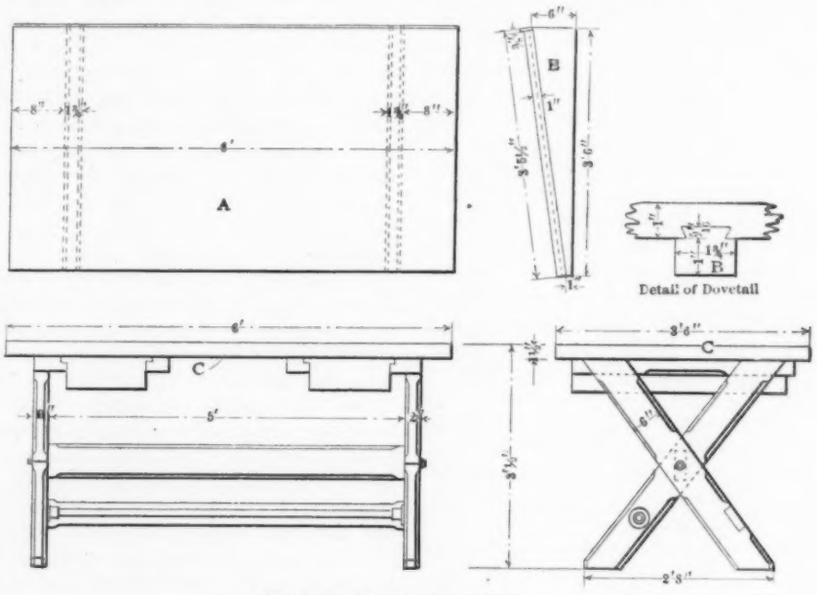
formed by one of the boys who sat next to me, that they were paid from 7 o'clock and had the choice of either going to work or to the service. W. L. McL.

Canada.

A Drawing Board and Table.

The accompanying sketch illustrates a drawing table that is used by a large concern employing about eighty draftsmen, and has proven very satisfactory. The full length of the board is not always needed, but it is just as easy to work on the left-hand end of this board as it is to use a smaller board; then you have all the right-hand end for your reference sheets, etc.

The top *A* or drawing board proper is made of 1-inch material tightly glued up, with two 1¾-inch inclined cleats *B* dovetailed to the bottom. At the top edge of the board is a ⅜-inch strip ½ inch



DRAWING BOARD AND TABLE.

high to prevent the instruments from being pushed over onto the floor. This board rests on the table *C* which is built a convenient hight from the floor and contains two drawers for books and instruments. The foot rail is a piece of 1¼-inch iron pipe; this was found to be far better than a wooden rail which soon chips off, due to the constant kicking of the feet, and presents a bad appearance. The legs are halved together, and the whole is a good rigid outfit. BAYARD.

California.

Tool Building in Great Britain.

From the earliest times the machine-tool trade in Great Britain has existed under unfavorable conditions for "manufacturing" as opposed to building to order. From the time when machine tools were mostly made on the premises of the users, the individual users of the tools have controlled the designs. In the time of Manchester's preëminence in the tool trade, it became common for a good design initiated by a particular firm to be thrown open for tender, its features being particularly described in the specification sent out. Thus a score of firms would have by them sets of patterns for identically the same machine. Government and private buyers of tools got into the way of specifying, not the duty and output, but the materials, dimensions and detailed design of the tools required. This system naturally put the trade on a low footing as regards responsibility, and also did not permit of a good shop organization, for the machine-tool makers never knew what kind of goods they might be making next month.

Thus, although the "manufacturing" idea was of course well understood in other lines of industry yet the conditions were such as to make its application impossible to the machine tool trade.

Then came the flood of American tools imported to this country (in the late 80's and through the bicycle boom of the 90's). Their reasonable cost and general excellence seemed to make the prospects of the English tool trade poorer than ever, but we learned at that time what manufacturing could accomplish in America.

But in the background all the time were the enormous requirements of the British Empire and other military and naval powers for war material. Our gun and ammunition factories, Government and private, were constantly requiring fresh equipments of machinery. Every new military or naval gun and its ammunition meant thousands of pounds to be spent in tools and the prices were good too.

During all the apparent slump in the English machine-tool trade certain firms in Lancashire, Yorkshire and the Midlands were fattening on this trade. But here again the conditions absolutely shut out the manufacturing idea; a tool ordered by, say, a government shop for a particular operation would not be accepted by, say, a private contractor for the same work; he wanted it some other way and got it too. Again, if either version were offered to another department, government or private, the official in authority there would certainly have it modified to meet his views or go elsewhere.

In Great Britain, generally speaking, any man who is a potential buyer of machine tools is quite confident that he knows far more of their design and construction than the toolmaker does, whereas in reality the toolmaker has, or should have the total of his own and his customer's experience, while a particular customer as a rule only has his own.

The result of all this has been a tremendous waste of money and energy. The pattern stores of an English tool maker would astonish some American machine builders and the shop organization brought about by these conditions is naturally chaotic.

This last six or seven years, however, firms have risen up (in some cases old established firms) in Scotland, Yorkshire and in the Midlands, who have realized the advantage of adopting the manufacturing idea, and while always keen to see improvements and to accept new conditions, they will not go out of the way to cater for mere fads. The goods they sell they conscientiously believe to be the best they can produce, and judging by their business and the extensions they are pushing out they are on the right track. F. C.

G.—England.

We have received from P. Dupressoir, Constructeur, La Manufacture Maubege (Nord), France, a lot of illustrations of châssis and details of the "Rolling" automobiles, from a little voiturette driven by a 6-horse-power single-cylinder De Dion motor, up to four-cylinder cars of 30 horse-power, both "propellor-shaft" and chain drives being shown The details are quite interesting. They include front axles and connections, controlling levers, handles, pedals, steering wheels, etc., friction clutches and fly-wheels, which are often combined together, steering gear operating by rack and pinion, by helical gears, and by screw and nut; speed-changing gears; differentials, among which we find gears on the same principle as illustrated in our series of articles on the construction of an automobile. The bevel-gear differential is also shown.

In a two-gallon efficiency test in which 71 automobiles contested, a four-cylinder 12-h.p. 1500-lb. car went 87 miles, starting from New York, on May 5. At a gasolene rate of 18 cents per gallon, the fuel cost is a little over ½ cent per ton-mile. The skill of the chauffeurs affected the distances considerably.

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Contents.

	PAGE
The Works of the L. S. Starrett Company at Athol, Mass.	693
Designing a Boring Mill	695
The Calculagraph	698
A Corliss Cylinder Boring Machine	702
Grinding Machine for Large Ball Races	703
The Question of Men and Salaries in the Drafting Room	706
A Press with Special Feed for Making Staples	707
Worm-Gear Design	708
Hand-Power Drill Grinder	709
Letters to the Editor: Welding Boiler Flues....Calculation of the Strength of a Crane Drum....Milling the Gap in Packing Rings....End Milling and Drilling in the Lathe....Forming Wire Loops....Measuring Screw-Thread Diameters....Roll Grinding....Metric Screw Threads—Rounding Threads at the Bottom....Cutting Racks on the Milling Machine....Split Dies—Holding Dies....Block Indexing on the Brown & Sharpe Gear Cutter....Gas Engine Powering....Standard Business Cards—Preserving Advertising Matter....A Drawing Board and Table....Tool Building in Great Britain	710-717
The Civic Federation's Commission to Study Municipal Ownership	718
Rent as Part of Operating Expenses	719
Telephones in New York	719
New Publications	719
New Tools and Machine-Shop Appliances	720
The Kaiserin Auguste Victoria	721
Personnel of the Civic Federation's Commission	721
Completion of the New Hydraulic Laboratory at the University of Wisconsin	721
Personal	722
Obituary	722

The Civic Federation's Commission to Study Municipal Ownership.

A contemporary remarks that "English municipal ownership will soon be the most thoroughly investigated thing alive," and while this may be true, we think that if it is, English municipal ownership will have a close race with our American railroads and insurance companies, all of which seem likely to be investigated before we have done with them; and it is apparent, also, that they are sadly in need of it; the need being the more apparent as the work goes on. Notwithstanding the bad record of the Pennsylvania Railroad, for instance, in connection with Standard Oil operations, Americans are generally rather proud of that road and are proud to think that its present management is in no respect very bad and in some respects very good. Yet the Interstate Commerce Commission, by an investigation now going on, is making a good many Pennsylvania Railroad officials look pretty yellow, and the state of affairs is so bad that the board has ordered an investigation on behalf of the road itself, while at the same time men representing the minority stockholders have also demanded a separate investigation. In the meantime, it has been made plain that one of the reasons why certain men depending upon the Pennsylvania Railroad for transportation of coal produced from their mines, and of other things which they might wish to ship, have been unable to do business successfully, is because certain officials of the road have accepted as gifts stocks in other and competing companies, which ownership of stock has naturally led them to favor these companies with respect to distribution of cars and in other ways, the result being that gross discrimination was shown. The same contemporary quoted above, which is one of the most conservative journals published in the country, remarks: "The half dozen officers of the Pennsylvania who prostituted their powers are in the way to make more converts to national ownership of railways than all the windy agitators of the last three decades."

The discussion has been given a new impetus here by an occurrence at the dinner of the Civic Federation in New York recently, which dinner was given to a commission, sent abroad by the Federation to investigate municipal ownership in Europe. At this dinner Supreme Court Justice William J. Gaynor, of New York, made an attack upon the management of public-service corporations generally, and of those which provide the transportation facilities of New York City particularly, in which attack he said among other things:

"The agitation here for municipal ownership and for municipal management of the great public service corporations has, in my judgment, arisen in no way from hostility to capital or hostility to private management. The live coal in the minds of the community was neither originated nor fanned into a glow by such hostility.

"On the contrary, it has arisen wholly from mismanagement of these enterprises in overcapitalization and in the watering of stock again and again. The community cannot regard without feeling, without regret, without resentment, and, finally, without action, this doubling and trebling and doubling again this capital put into these public franchises in a way to make them a perpetual tax on the people."

With all due respect to Judge Gaynor, it seems to us that this misses the point. If a corporation is given, if it steals, or if it otherwise obtains a franchise without limitations and in such form that it may do as it pleases with that franchise, then we cannot see that the watering of its stock, in order to keep down the percentage of dividends, has much, if any, bearing upon the matter. It is true that the watering of the stock and other manipulations which take place are a part of the game by which the profits of such public-service corporations are concealed, and the unthinking public made to believe that the profits are not excessive. But this is only a detail, and the essence of the difficulty is in the fact that a private corporation is allowed to own a franchise, which franchise is so drawn as not to protect the rights of the public.

Supposing that a company absolutely owns an unlimited franchise to operate a certain street railway; that no limitations are placed upon its earnings, nor upon the life of the franchise; it is acknowledged that this franchise has been properly obtained, and that it belongs absolutely to the company claiming its ownership in the same way that a machine shop belongs to the man who has built or purchased it, then we cannot see why the public has any right to limit the earnings the company can make from the operation of the road, any more than it has a right to limit the earnings of the man who owns the machine shop. The important difference is that in the machine-shop business there can be plenty of competition, and there will be as soon as there is room for it if not a little before; whereas in the operation of a city street railway, or of other railways, there can be no such thing as open and free competition, and the rights of the public must be secured in some other way. They cannot, however, be secured by attempts to limit the watering of stocks, or by the imposition of rules requiring publicity of the corporation's affairs, etc.

The committee sent abroad by the Civic Federation is, we think a good and probably a well-balanced one. It will in all probability make two distinct reports which will differ from each other radically, though it is to be hoped at least that the two reports taken together will

throw additional light upon the much and increasingly discussed subject.

In this connection, it is pertinent to remark perhaps that there is a good deal of misapprehension regarding the actual results of municipal ownership abroad, owing to the fact that we look upon industrial and business organizations with somewhat different eyes than those with which they are viewed by Europeans. Americans are in the habit, for instance, of comparing certain municipally owned enterprises in Great Britain with privately owned enterprises here to the detriment of the former, and charging all the alleged inferiority to the fact that the European institution is municipally owned and operated, whereas, as a matter of fact, these same Americans often find fully as much to criticize in European industrial and business organizations which are not at all municipally owned, and which alleged fault exists simply because the people over there have not our ideas as to how things should be done. In the way they run their hotels, for instance, in the way they heat their dwellings and public buildings, in the way they carry on certain of their manufacturing enterprises, Americans have found, and do find, very much to criticize, this criticism extending to the management of British railways. None of these things are owned or administered by the public, but are private enterprises, and the reason some of us find so much in them to criticize is simply because they do not suit our ideas of how such affairs should be managed.

British management of such things does not at all suggest Hottentots but to give an extreme illustration, let us suppose a tribe of Hottentots organize a street-railway system. If it should be publicly owned and administered, it would be foolish for us to say that the reason it was inefficiently or poorly managed was because it was publicly owned and administered. The real reason would be that it was owned and administered by Hottentots, and the probability is that it would be no better managed if it were privately owned and administered by those same Hottentots. These matters are largely of temperament and of what suits or meets the requirements of the people for whose use such things are operated. Allowances should, we think, be made for these things when making comparisons between the different countries. "It is by no means proven that the alleged backwardness in the development of electric lighting, power and traction in English and Continental practice is due to the hampering effect upon the development of electrical industry by municipal or public ownership and operation." It may be, and probably is, due to a greater or less extent to the fact that the people doing the work are not the same people and are not to be judged, nor their work estimated, by our standards; whether ours be actually higher or lower than theirs is another question. It is a common fault of Americans to conclude that anything done abroad differently from the way we do it here must necessarily be not so well done: whereas a little patient and intelligent investigation might show that in many instances it is really better done, considering all the conditions.

Rent as Part of Operating Expenses.

There is considerable difference of opinion among cost accountants as to whether interest and rent should be considered as parts of the operating expenses of a manufacturing establishment. There are those who think they should not, while there are others who think they should. An analogous point is likely to be decided by the courts in New York, owing to a difference that has arisen between the municipal authorities and the Interboro Railway Company in respect of the payment that is alleged to be due the city under the agreement between the city and the company. The company claims that it should properly charge the annual rental of $1,249,453 as a part of its operating expenses, and that this amount should be deducted from the gross earnings in addition to other sums before the first annual 1 per cent. payment toward the redemption of the Subway Construction Bonds will be due. The city authorities on the other hand claim that this rental is not to be considered as part of the operating expenses and must not be deducted, but that the 1 per cent. must be paid before such deduction is made. It is not unlikely that the courts will be called upon to decide the point, which will be an interesting one.

Telephones in New York.

We have previously commented upon the curious telephone situation in New York, and have recently received a publication entitled "Telephone Competition in Various American Cities." This consists of a report of an investigation by the Merchants' Association of New York, and presents what we think is very strong evidence against the wisdom of permitting telephone competition or a multiplicity of telephone companies covering the same territory.

Of course we recognize that there is abundant testimony showing that competition has improved the character of the service and has very much reduced the charges in certain cities. But this is only because the first company has had an unlimited monopoly; that is, a franchise without proper restriction and managers foolish enough to maintain such conditions as to cause its patrons to insist upon competition being established. The New York Telephone Company is pursuing a different course. It proposes to place its business practically in the hands of the public; in other words, to surrender most of its monopoly power in order to avoid the evils of competition. And we can see no other result but a favorable one from such an arrangement. One thing seems to be pretty well settled and that is that in telephone service, monopoly is unbearable; but it seems equally clear that the way to avoid these evils is not by instituting competing companies, but by the public assuming more or less control of the monopoly, so that the interests of the users of telephones will be protected.

New Publications.

"The Indicator Handbook. Part 1. The Indicator; its Construction and Application." By C. N. Pickworth. Third edition, 130 5x7¼-inch pages, with 81 illustrations. Emmot & Co., London and Manchester; D. Van Nostrand Company, New York.

This edition of a well known book has been enlarged by the inclusion of illustrations and descriptions of various forms of continuous indicators which are receiving deservedly increased attention. A feature which does not always receive the attention which it deserves is the errors of various forms of reducing gear, which are shown in graphic form.

Another specialized journal has entered the field, called *Selling Magazine*. It is devoted to the art and science of marketing machinery, tools, equipment and supplies. The first number is filled with very readable and also very valuable articles, among which are "A Belting Business of $1,700,000 Annually," by Chas. A. Schieren Jr.; "Publicity and Machinery," by Arthur Warren; "The cost of Selling Prime Movers," by R. H. Reed; "A talk on Circulation," by W. H. Taylor; Selling Goods in Foreign Countries, Modern Methods of Marketing Machinery, German Methods of Selling in Foreign Countries, The Machine Tool Builders' Meeting, Consular Reports, etc.

The new magazine is published by Emerson P. Harris, who has had much experience with trade and technical journals and knows how. It is edited by John A. Kershaw, who for some years has been an advertising expert with the AMERICAN MACHINIST and knows the business thoroughly. Published at 256 Broadway, New York, monthly at $1 per year.

A correspondent would like to see in our columns an article on molding automobile engine cylinders with water jackets, and we shall be glad to receive such an article from anyone having had experience in that work.

The address is desired of the maker of the Emerson Power Scale.

Carbon tetrachloride surpasses other liquid solvents of oils, it is also non-inflammable.

New Tools and Machine Shop Appliances.

A COMBINATION GRINDER.

The illlustration shows on one base a combination grinder for drills, cutters and reamers.

The relation between the V-rest for the drill, and the axis upon which it oscillates is such that each drill is self-adjusting, and there is no further adjustment for diameter necessary.

The large sizes of straight and spiral milling cutters and shell reamers are supported on the main bar. Small cutters whose bore is less than the diameter of this bar can be supported on an arbor between the centers. For bevel cutters a swivel head is provided which clamps to the main bar and can be swiveled to any angle. Straight and taper reamers are ground on centers, the center being supported in the swivel head used for grinding angle cutters.

The driving pulley on the drill grinder is 4¾ inches diameter and the driven pulley on the cutter grinder 1½ inches diameter for 1-inch belt.

A COMBINATION GRINDER.

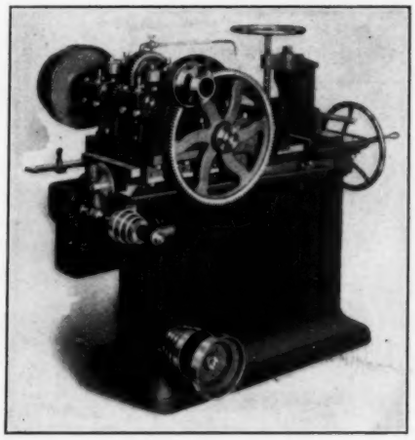
The cutter grinder spindle is hardened and ground, and runs in an eccentric sleeve to which a handle is attached. This handle is shown to the right of the emery wheel in a nearly perpendicular position. The adjustment of the emery wheel to or from the work is by means of this eccentric sleeve. The emery wheel used is 2½ inches diameter by ½-inch face.

This machine is made by Wilmarth and Morman Company, Grand Rapids, Mich.

A CUTTING-OFF SAW.

The illustration shows a cold saw carrying an 18-inch saw and capable of cutting off round bars up to 7 inches diameter. The drive of the machine is through spur-gearing, made of 50 carbon steel, running in oil. The gears are enclosed to protect them from dirt and chips. In this machine back gears have been introduced, giving a ratio of 19½ to 1 between the cone pulley and the saw.

The cone pulley has two steps 10 and 12 inches diameter for 3-inch belt. The machine can also be arranged for motor drive. Drip and chip pans are provided, which connect with a reservoir which supplies the pump with lubricant for the saw. The floor space occupied is 2 feet 6 inches by 4 feet 8 inches; the weight is 2300 lb. A larger machine is also built, which will cut off bars up to 10 inches diameter with a 25-inch saw; it occupies floor space 2 feet 9 inches by 5 feet 9 inches, and weighs 3000 pounds.



A CUTTING-OFF SAW.

These machines are built by Nutter, Barnes & Co., 366 Atlantic avenue, Boston, Mass.

A TUYERE IRON.

The illustrations show a new tuyere iron which has recently been brought out, and which possesses some novel features. This tuyere is equipped with an automatic vent *H* Fig. 2, which is closed when the blast is on and opened by gravity when the blast is off. When the blast is shut off, sufficient air is admitted through *H* to keep the fire lit; further, the air-current passing through *H* and up through the fire prevents explosive gases collecting in the blast pipe. It is a well known fact that when the fan stops without the blast pipe being shut off, these explosive gases do collect in the pipe, and that serious explosions occur when the fan is started again, sometimes wrecking the forges and shattering the blast pipes. The cinder box *B* is covered at one end by a swivel cap *A*, which is operated either by hand or reach rod, permiting the full opening of the cinder box for blowing out accumulated cinders.

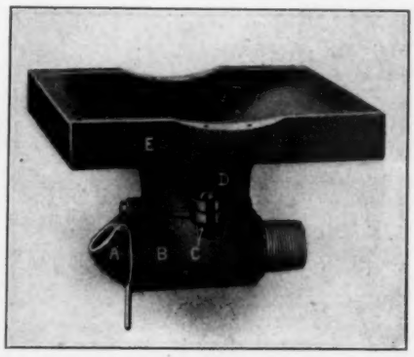


FIG. 1. A TUYERE IRON.

The tuyeres are made in four parts so as to avoid the necessity of replacing the whole tuyere in case a single part becomes worn, burnt out or broken. Two grates—as shown at *F* and *G*, Fig. 2—are supplied.

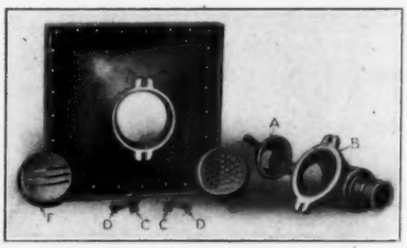


FIG. 2. THE PARTS OF THE TUYERE.

This tuyere iron is made by The Hoosier Forge Company, Connersville, Ind.

AN AUTOMOBILE WHEEL.

The line cuts show the construction of an automobile wheel invented by our contributor, T. W. Broomell, of Watertown, N. Y.; his description of the wheel is as follows:

The wheel shown overcomes the necessity of using pneumatic tires on automobile wheels.

It will be seen by reference to the cuts, that the necessary resilience is obtained by the use of spiral springs contained in the steel thimbles, *D*, which in turn are placed in steel sockets *A*, screwed in the hub of the wheel. There are twelve of these thimbles and sockets, each of which contains two steel spiral springs, one inside of the other. The cuts show only single springs. Six of the thimbles and sockets are placed on each end of the hub. There are, therefore, twenty-four springs, or rather the thimbles containing these, in contact with the inner hub *B* resting on the collars *HH*. This inner hub, when the wheel is a driver, is keyed to the driving shaft or axle. It has, as shown at *K*, Figs. 2 and 3, a flange, and the outer or hub proper is provided with an annular recess *O*, in which the flange *K* moves freely either vertically or horizontally, the recess being sufficiently large in diameter to allow of the necessary movement caused by the resilience of the springs; this flange also holds the entire wheel rigidly in a perpendicular position. The inner hub and the outer or hub proper being entirely separate and independent of each other, it is necessary to transmit the power from the inner to the outer hub. This is done by the pins and rollers *C* and *S*

shown in Figs. 2 and 4. The pin passes through the outer hub and on it the rollers *C* run freely. The inner hub Fig. 4 has two openings *PP* in its flange. These are much wider than the diameters of the rollers which are contained in them, and which receive the power from the flange *K*. At Fig. 4, the rollers are shown in contact with opposite surfaces of the slot or opening, being driven by the flange *K*. These rollers and pins do not prevent resilience for the reason that should a shock occur when the rollers are in line perpendicularly, they are free to slide in a perpendicular direction; should a shock occur when they are on the same horizontal plane, one of them leaves the surface of the flange as shown by the dotted lines, while the other remains against the flange and continues to transmit the power.

This wheel has been in use during the past season, works perfectly, shows no weak points and gives very satisfactory results.

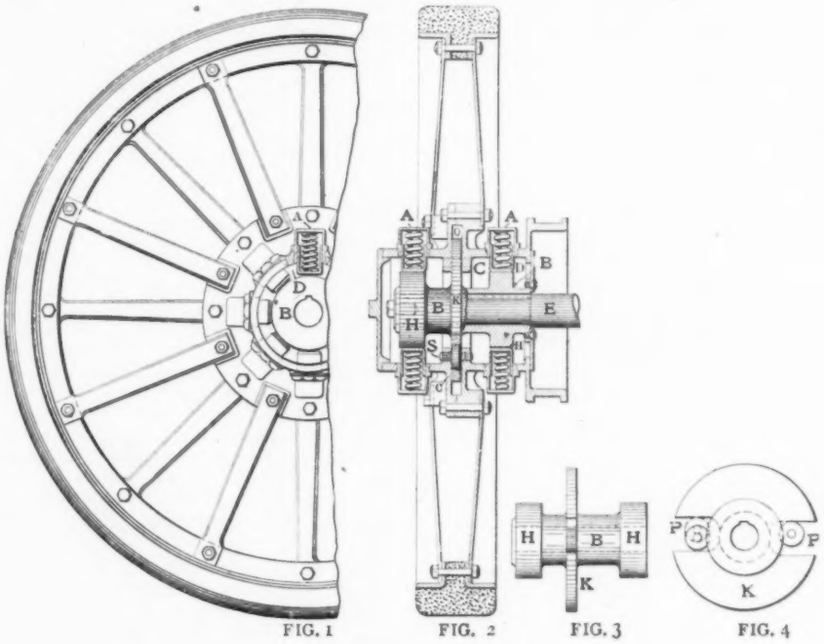


FIG. 1 FIG. 2 FIG. 3 FIG. 4

AN AUTOMOBILE WHEEL.

The Kaiserin Auguste Victoria.

A lunch was tendered to the representatives of the press May 21, on board this, the largest ship in the world. The lunch which included *baked* ice cream was an entire success. The ship is magnificently fitted. There is a complete telephone system, a palm garden, a gymnasium, an *a la carte* restaurant. The navigating bridge is equipped with steering and engine-room telegraphs. On either side are permanent "dodgers" with sliding windows so that the officers on watch are well protected.

The engines are quadruple expansion. The high-pressure cylinder is forward, next comes the 2nd intermediate, then the low pressure and furthest aft the 1st intermediate. Very little information was forthcoming about the engines as owing to the fact that the crew was green the engineers had their hands full. On her trial trip our representative was informed the engines made 94 r.p.m., and developed about 9400 h.p. each, 18,800 h.p. for both engines.

Owing to a strike in Germany at the time she left she was unable to get a crew of firemen and consequently two-thirds of the men were "beachcombers" and "dock rats." This accounts for the moderate speed made on her maiden run, the chances are she will do considerably better with a good crew.

Personnel of the Civic Federation's Commission.

The Commission sent to Europe by the Civic Federation to study municipal ownership which is referred to elsewhere in this issue, consists of M. E. Ingalls, president of the Big Four Railroad; Prof. Frank J. Goodnow, of Columbia; Walton Clark, third vice-president of the United Gas Improvement Company of Philadelphia; Edward W. Bemis, superintendent of the water works at Cleveland; Prof. John H. Gray, of Northwestern University, Timothy Healy, president of the international Brotherhood of Electrical Firemen; William J. Clark, foreign manager of the General Electric Company; Frank Parsons, president of the National Public Ownership League; J. W. Sullivan, editor of *The Clothing Trades Bulletin;* F. J. McNulty, president of the International Brotherhood of Electrical Workers; Albert E. Winchester, superintendent of the South Norwalk Electric Light Works; Charles L. Edgar, president of the Edison Electric and Illuminating Company of Boston; Milo R. Malthie and Edward A. Moffett, editor of *The Bricklayer and Mason.*

Completion of the New Hydraulic Laboratory at the University of Wisconsin.

The new hydraulic laboratory at the University of Wisconsin is now practically completed. The laboratory is well equipped for investigation of problems of water power and water supply, the importance of which in commercial, municipal and sanitary engineering is rapidly increasing. Students interested in these phases of engineering may now study and test the principles of hydraulics involved in water power, swamp drainage, irrigation, sewage disposal, and similar practical subjects. The new hydraulic laboratory at the university has been established in response to the increased demand for students especially trained in hydraulics.

The new hydraulic laboratory is located on the shore of Lake Mendota near the college of engineering and immediately adjoining the university pumping station and tank house. The location is an excellent one, since an unlimited quantity of water is available. The university pumping station, together with the storage reservoir on the bluff of the lake fifty feet above the laboratory furnish the necessary water for experimentation.

The building is constructed of reinforced concrete. It is 48x98 feet, and three stories high including the basement, which is 1½ feet above the water level of the lake. In the basement are located an engine room and a large Morris centrifugal pump and a number of measuring tanks, together with the laboratory for special work, and the head and tail races extending the entire length of the building.

LARGE VOLUME OF WATER AVAILABLE.

The large centrifugal pump, with a 30-inch suction and 30-inch discharge pipe, has a capacity of 25,000 gallons per minute. The water is pumped into the receiving chamber from double-head gates open into the raceway extending almost the entire length of the building. In the raceway, which is 10 feet wide and 10 feet deep, a volume of from 25,000 to 35,000 gallons of water per minute will be available for experimental purposes. In this channel the measurements of flow may be made with various depths of water, and with various temporary restrictions. A small channel 4½ feet wide and deep has been constructed parallel to and adjoining the large one for use in connection with channel experiments on a smaller scale. Below this is a 30-inch circular concrete conduit in which the phenomena of the flow in closed channels may be studied.

FOUR NEW TURBINES.

A large turbine with a 30-inch wheel which will develop 50-horse-power, is located at the west end of the ten-foot channel from which it receives its water supply. After passing the wheel the water is discharged into a tail race 10 feet in width in which is arranged a standard weir. This weir, in connection with the Prony brake on the wheel will promote the correct determination of quantities, velocity, and efficiencies of the flow of water under various conditions. Three smaller turbines are set in a separate well, and receive their water through separate smaller channels.

FILTERS FOR SANITARY WORK.

For the study of the purification of water by filtration, four water filters of different types have been installed in the new laboratory. Two of these filters are of the slow sand type, and consist of tanks six feet in diameter and eight feet deep. The filter equipment also includes a new Jewell gravity filter, and a mechanical filter with Norwood strainers presented by the Norwood Engineering Company. These filters have been fully equipped for experimental work, and afford excellent opportunity for the study of various methods of filtration of water, under conditions that prevail in municipal and sanitary engineering.

TWO HYDRAULIC RAMS.

The new laboratory has been provided with two hydraulic rams. One of these has been especially designed for experimental purposes, with a view to making possible a careful study of valves and air chamber capacities in relation to the efficiency of a ram. The new ram, which will have a four-inch drive-pipe, will make possible experience on a larger and more satisfactory scale than has been possible heretofore.

Two tanks are provided for the determination of the friction of water flowing through gravel or sand. A larger tank will also be constructed for the study of the laws of the passage of ground water through sand and soils and the principles controlling the operation of wells.

MUCH EXPERIMENTAL APPARATUS.

Apparatus has been provided for the study of the flow of water in straight and curved pipes and hose of various sizes and materials, also for the investigation of losses due to sudden expansion and contraction and to valves and other forms of restricted passages. The laboratory is also supplied with various reciprocating pumps, centrifugal pumps, vacuum pumps, jet pumps, and various water meters, including those of the disk, piston and Venturi types. A large assortment of accurate apparatus for the measurement of quantities, velocities and pressures, both in open and closed channels, is available in the laboratory. Arrangements have been made for the careful and accurate investigation of various types of instruments and of the methods used in conducting hydraulic experiments.

FOR DEMONSTRATION LECTURES.

On the upper floor of the laboratory is a large lecture room provided with apparatus by means of which many simple forms of experiments can be performed before the class in theoretical hydraulics. It will thus be possible, by means of actual and visible demonstration, to emphasize and impress on the minds of the students the general principles of hydraulics. By this radical improvement in the method of teaching theoretical hydraulics, it is believed that the information can be conveyed to the students in a more thorough and effective manner. The laboratory work includes experiments familiarizing the students with the application of the most important principles encountered in theoretical work.

OPPORTUNITY FOR RESEARCH.

In the new laboratory special attention will be given to advancing research work. It is intended to direct the students' thesis work into lines in which further information is desired, and from which valuable results can be obtained. Results of interest will be further investigated, checked and extended, with a view to publishing the conclusions whenever they are of general interest and importance.

The construction of the laboratory marks a great advance in the opportunity and character of investigation in hydraulics in the university, and it is undisputed that the opportunities for research work will have considerable influence in the advance of knowledge of this important subject.

Personal.

W. S. Barstow, formerly manager of the Edison system in Brooklyn, J. B. Taylor, late with Westinghouse, Church, Kerr & Co., and R. L. Donald, recently with the Southern Pacific Railroad, have formed an engineering firm incorporated under the title of W. S. Barstow & Co. They have opened offices at 56 Pine Street, New York City, and in the Failing Building, Portland, Oregon, and will undertake the designing and construction of electric lighting, railway and power plants and distributing systems, the construction of industrial plants, etc.

Obituary.

Garrett Van Iderstine, a noted marine engineer who died at Newark, N. J., May 22, at the age of 68, was born in Passaic, and spent the first eleven years of his sea life as engineer on steamers in Chinese waters. In the Civil War he was chief engineer of the Government ship "Flambeau," and saw some lively service in the Gulf. Later he was engaged in the same capacity on the Brazilian Mail Line, and when the Brazilian war broke out he was commissioned by Dom Pedro to run the warship "Nictheroy" from New York, where she had been purchased by the Brazilian Government, into Rio de Janeiro. She had to run the gantlet of the enemy's warships, and at the end of three months' service the Government made him a gift of $7000. At other times he was employed as chief engineer of the Clyde, Morgan, and other mercantile lines.

Business Items.

The Stanley-G. I. Electric Manufacturing Company's San Francisco office, which is now occupying temporary quarters in the Blake Block, Oakland, announces that it will move next week into rooms 403, 404 and 405 Atlas Building, 604 Mission street, San Francisco.

During the Master Car Builders' and Master Mechanics' conventions to be held at Atlantic City, June 13-20, the Niles-Bement-Pond Company will have on exhibition and in full operation one of its extra heavy 90-inch driving-wheel chucking lathes. Owing to its great weight this machine cannot be shown on the steel pier. This company therefore has built a special booth two minutes' walk south from the Pennsylvania station on New York avenue, near Atlantic avenue, where the machine will be on exhibition.

Manufacturers.

The Duluth (Minn.) Brass Foundry Company will erect a new foundry.

The Joshua Hendy Machine Works, of San Francisco, will rebuild in Sunnyvale, Cal.

The Johns-Pratt Company, Hartford, Conn., which manufactures asbestos, will enlarge its plant.

The Baltimore & Ohio Railroad has prepared plans for a large sawmill at Mount Clare.

The Foran Foundry and Manufacturing Company, Flemington, N. J., is enlarging its plant.

The Bessemer City (N. C.) Cotton Mills will build a finishing plant to cost about $20,000.

The Wabash Railroad will build new car shops at Oakwood, Mich., at an expenditure of nearly $500,000.

George Sauber, Amherst, N. S., who is now operating an electro-plating plant, is erecting a brass foundry.

The Whitney Manufacturing Company, Hartford, Conn., machine builders, etc., will erect a new plant.

The Omaha (Neb.) Electric Light and Power Company will build a $7,500 addition to its power house.

A one-story addition will be built to the brass and copper tube plant of A. H. Wells & Co., Waterbury, Conn.

The Irwin-Hughes Company, Whitener, Ark., has plans completed for the erection of a large wood-working pant.

The M. B. Farrin Lumber Company, Cincinnati, Ohio, is arranging for the erection of an additional lumber house.

Joseph Bancroft & Sons Company, cotton finishers, etc., Wilmington, Del., will build an addition to its Kentmore plant.

The Middletown (Pa.) Car Works is receiving bids for a new building to be used for the manufacture of steel cars.

The Spokane (Wash.) Canning Company, a

new concern, is putting up a plant. W. H. Stanley is president and treasurer.

Fred N. Burt, Buffalo, N. Y., has bought a factory, which will be improved and equipped for the manufacture of paper boxes.

S. F. Bowser & Company, Fort Wayne, Ind., manufacturing oil tanks and pumps, will build a branch plant in Toronto, Canada.

The De Ford Buggy Manufacturing Company, of Nashville, Tenn., which has recently been incorporated, will build a $25,000 factory.

James Cate, J. H. Cate and John T. Edwards, of Hopkinsville, Ky., have filed articles of incorporation for a woolen mill. Capital, $25,000.

The Keystone Block Machine Company, a new concern, will erect a plant in McKeesport, Pa. L. Vilsack, W. R. Kuhn and E. F. Hollinger, of Pittsburg, are interested.

The Smith Foundry Company, of Alverton, Pa., will locate its plant in Youngwood, Pa. C. H. Smith, Justice of the Peace, Alverton, is the chief stockholder in the company.

Dodge & Day, Philadelphia, Pa., have the contract to design, erect and equip a new plant for the Kerr-Murray Manufacturing Company, Fort Wayne, Ind., makers of gasworks machinery.

The Billings & Spencer Company, Hartford, Conn., manufacturing drop forgings and tools, is getting out plans for a large addition to its factory. It will cost about $50,000 and be used for heavy machine work.

The new power house and equipment of the Norfolk (Va.) Railway and Light Company, plans for which are being prepared, will cost about $1,000,000. A system of electric coal handling apparatus will be installed.

The Roanoke Rapids Paper Manufacturing Company is being formed to build a plant for the manufacture of pulp and paper. A. H. Christian, Jr., E. B. Addison, T. C. Williams, Jr., of Richmond, Va., and others are connected with the enterprise.

The Marion (Ind.) Iron and Brass Bed Company will build a new factory, to be equipped with power, lighting and heating apparatus, blowers for kilns, trolleys, industrial railway, etc. Hugo Diemer, Commercial Club Building, Indianapolis, Ind., is consulting engineer on equipment.

The Chesapeake Sugar Refining Company, of Baltimore, Md., has been incorporated with $1,500,000 capital. A plant will be erected at Wagner's Point, Md. Travers K. Carey, member of the Baltimore bar and president of the National Sugar Manufacturing Company, will be president of the new concern.

Catalogs.

The Vitrified Wheel Company, Westfield, Mass. Catalog of emery and corundum wheels. Illustrated, 6x9, pp. 63, paper.

The Rivett-Dock Company, Brighton, Boston, Mass. Catalog of thread tools and cutter grinder. Illustrated, 6x9, pp. 31, paper.

The Carlyle Johnson Machine Company, 356 Asylum St., Hartford, Conn. Catalog of friction clutches. Illustrated, 3½x6½, pp. 20, paper.

National Machinery Company, Tiffin, Ohio. Bulletin No. 20, illustrating and describing multiple spindle bolt cutters. 8½x10½, pp. 28, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Patented foot hoe; will let on royalty. Bert. Shannon, Sloan, Iowa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Cantpickem metal bench-drawer slides, better than wood; give length. Mutual Patent Exchange, Milwaukee, Wis.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted — To complete volume, AMERICAN MACHINIST of April 13, 1905. Will pay premium. Box 613, AMERICAN MACHINIST.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Established Canadian company wants metal articles in screws, stampings and machine parts to manufacture. "Specialties," Box 611, AMERICAN MACHINIST.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Shop organizer—Little defects in tools, product and shop organization consume profits. For a moderate outlay I will visit your factory and reduce your manufacturing cost to the minimum. Thirty years' experience. C. E. Tower, 1237 Monadnock Block, Chicago.

Trained men are in constant demand at high salaries. Our seven-weeks' course fits you to drive, maintain and repair all gasolene cars. Day and evening classes. Inspection of building solicited. New York School of Automobile Engineers, 146 West Fifty-sixth street, New York.

Wanted to purchase—Cleveland automatic screw machines with plain plungers and full Cleveland automatics; also 2-inch hollow spindle capstan lathes and larger. State full particulars regarding the condition of the machines and lowest price for same to the Auto Machinery Company, Ltd. ,Coventry, England.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until **10 o'clock a. m.**, June 19, 1906, and publicly opened immediately thereafter, to furnish at the navy-yard, New York, N. Y., a quantity of machine tools, as follows: **Sch. 562**: Metal saw.—**Sch. 564**: Trimming press, steam hammer, wood lathe, rip-saw.—**Sch. 565**: Pipe bender. Applications for proposals should designate the schedules desired by number. Blank proposals will be furnished upon application to the navy pay office, New York, N. Y., or to the Bureau. H. T. B. HARRIS, *Paymaster-General U. S. N.* 5-12-06

For Sale.

For Sale—Foundry, wood and iron machine shops, Albion, N. Y., Box 74.

For Sale—Machine shop, $3000. Warren Motorcycle and Auto Repair Co., Warren, O.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AMERICAN MACHINIST.

For Sale—Second-hand 20x24 Atlas engine, heavy duty, automatic type, right hand with 9'x26" band wheel, speed 160 r.p.m. In good condition. Address Box 1, Columbus, Ohio.

For Sale—Machinery-manufacturing plant, including machinery, tools, jigs and good will. Doing a business of from $100,000 to $150,000 per year; can secure buildings with water power at very reasonable rent for term of years. Address J., Box 649, AMER. MACH.

Business Opportunities.

Assistant superintendent for gas and gasolene-engine company; must buy an interest. Old money-making concern; high standing. Good salary. L. D., Box 646, AMER. MACH.

Young man (31) technically educated, machinist by trade, desires position in foundry and machine shop. Will invest $5000 in business at end of two years. Box 644, AM. M.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

GEORGIA.

Position as superintendent or general foreman on engines, air compressors, general machine-shop work. Box 647, AMER. MACHINIST.

ILLINOIS.

Mechanical superintendent, 33, desires change; small city preferred; best references. Box 643, AMERICAN MACHINIST.

INDIANA.

Superintendent wishes to make a change; power-transmission line preferred; fully acquainted with modern shop practice; can reduce cost and systematize plant. Box 640, AMERICAN MACHINIST.

NEW JERSEY.

Experienced draftsman wishes to make change. Apply, giving full particulars, to Box 622, AMERICAN MACHINIST.

Engineer desires change; where now employed has charge of drafting room, shops, power plant, construction and maintenance and purchasing department; thorough practical training in all branches. Box 580, AM. M.

NEW YORK.

Responsible position in steam turbine manufacture; several years' experience. Box 631, AMERICAN MACHINIST.

Position as foundry foreman by a first-class man; capable, energetic and willing. Box 637, AMERICAN MACHINIST.

Mechanical draftsman, three years' experience and two years' shop work, desires position. Box 639, AMERICAN MACHINIST.

Cost accountant, purchasing agent, familiar with premium system, 10 years' experience, good systematizer, now in automobile line, desires change. Box 653, AMER. MACHINIST.

Young man, 27, German, practical mechanic with 12 years' experience, and knowledge of German, French and English, wishes position; electrical branch preferred. Address C. H. G., Box 651, AMERICAN MACHINIST.

A business woman of experience wants a position as advertising manager of a manufacturing concern in Eastern territory. Has had charge in two large concerns and refers to both. Capable of writing all ads, booklets, catalogs, etc.; familiar with all details of printing and illustrating. Box 542, AM. M.

OHIO.

Wanted — Position as superintendent by energetic young man holding responsible position with concern in which he owns stock, desires change. Box 654, AMER. MACHINIST.

PENNSYLVANIA.

Foreman pattern-maker, 14 years' experience, would like to make a change. Six years with present firm; young man, sober, and with family. Box 603, AMERICAN MACHINIST.

Experienced mechanical draftsman, with thorough theoretical knowledge and shop practice, German university graduate; state particulars. Box 652, AMERICAN MACHINIST.

Wanted—Position as superintendent by man of character and ability; has had wide experience and is conversant with modern shop and foundry methods; shop management and organization a specialty; best of references. Box 648, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Competent superintendent would like to change; experienced toolmaker, tool designer, master mechanic and superintendent; 16 years' experience in the commercial manufacturing of small and medium interchangeable machinery; position preferred with some typewriter, adding machine or automobile manufacturing company; a cost reducer. Box 650, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Machinist—Young man with experience in making twist drills and milling cutters. Address Box 635, AMERICAN MACHINIST.

Wanted — Competent toolmakers for gage and fixture work. Write fully as regards experience and wages expected. Apply Ross Rifle Company, Quebec, Canada.

Wanted—First-class general foreman for machine shop in Canada employing 500 men, on large and small mechanical and electrical work. Apply, stating past experience, salary expected, when available, to Box 638 AM. M.

Mouldmaker — One thoroughly familiar with work required for rubber factory; must be able to make his own tools and jigs. Write, stating experience and wages expected, to Mr. Whyte, P.O. Box 2267, Montreal, Canada.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Machinists—We have positions for good floor and bench hands. Steady work and good wages. Printing-press work. Address The Brown Cotton Gin Co., New London, Conn.

We are now located in our new buildings, with an up-to-date equipment, and solicit applications from first-class toolmakers, diemakers and machinists for high-grade work. Apply, stating age and experience, to The Yale & Towne Mfg. Co., Stamford, Conn.

ILLINOIS.

Wanted, draftsmen — We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to Western Electric Company, Dept. No. 29, Chicago.

INDIANA.

Wanted—A-1 mechanic to act as working foreman in a small shop on light, high grade, accurate and interchangeable work; who can design and make up-to-date tools for accurate and rapid production. Give age, experience and wages wanted. Box 636, AM. MACHINIST.

Wanted—A good foreman to take charge of machine shop working about 35 to 40 men; one who is acquainted with automobile-engine work preferred. State age and experience, give reference and state salary wanted. A good position to the right man. Box 642, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Good mechanical draftsmen for designing electrical and steam apparatus; also a few good detail draftsmen. Positions offer good prospects for advancement and are to be considered permanent for the right men. Send detailed statement as to age, education, experience and initial salary to Engineer in charge, Drawing Office, General Electric Co., West Lynn, Mass.

MICHIGAN.

Turret-lathe operator wanted for 21-inch American turret lathe; steady employment to man who can rush out the work. Northern Engineering Works, Detroit, Mich.

MINNESOTA.

Wanted—First-class machinists, moulders and pattern-makers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel and Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Foundry foreman wanted in open shop. Give reference, experience, and state salary expected. Box 583, AMERICAN MACHINIST.

Wanted—Foreman with experience in erecting high-speed automatic engines. Reply, stating experience and pay expected. Box 587, AMERICAN MACHINIST.

Wanted—First-class mechanical draftsmen for a large concern in the vicinity of New York City. Give age, experience, reference and salary expected. Box 577, AMER. MACH.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

NEW YORK.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Ingersoll-Rand Co., Painted Post, N. Y., is rapidly increasing force and invites applications from machinists for all branches of the trade. Excellent opportunity is offered energetic, capable young men. Box 641, AM. M.

Wanted—First-class mechanical engineer as purchasing agent; only one having experience in purchasing need apply. State full particulars as to references, salary, etc. Eastern or Pennsylvania man preferred. Address X Y Z, Box 617, AMERICAN MACHINIST.

We are permanently increasing our capacity and require the services of 20 mechanical draftsmen for detail work. Attractive positions to suitable men. Location in New York City. Address, stating age, experience and salary expected, Box 627, AMER. MACHINIST.

Wanted — Machinist with road experience as salesman, calling on all iron-working plants. Knowledge of turrets, automatics and threading machines, cutting tools and dies essential. State age, experience, salary expected and references. Box 618. AM. MACH.

Wanted—Young man, experienced mechanic and manager of men and work, as department foreman; light and medium duplicate work. Permanent, with opportunities for advancement. State in detail past experience, length time each position, age, salary wanted to start with. Manufacturer, Box 974, Buffalo, N. Y.

OHIO.

Wanted—A first-class, competent foundry foreman. Box 610, AMERICAN MACHINIST.

Wanted—Experienced foreman for screw department of manufacturing concern. Box 575, AMERICAN MACHINIST.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 609, AMERICAN MACHINIST.

The National Metal Trades Association can place a few first-class wood pattern-makers, toolmakers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, O.

Toolmakers, experienced on compound punch and die work. Boring-mill operators, experienced on close work on large vertical boring mills. No trouble. Best of rates to A-1 men. Apply to The Bullock Electric Mfg. Co., East Norwood, Cincinnati, O.

PENNSYLVANIA.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 578, AMERICAN MACHINIST.

Wanted—Thoroughly experienced erecting machinists, accustomed to steam engine or compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Fifty first-class toolmakers or machinists; good wages to right parties; no labor troubles. Driggs-Seabury Ordnance Corporation, Sharon, Pa.

Wanted—First-class instrument and toolmakers; also large machine-tool operators. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred. Only first-class men need apply. Address, Chief Draftsman, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. (P. O. Box 911.)

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: character, common sense, experience with automatic machinery, (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

VIRGINIA.

Wanted—Die sinkers and steam hammer men; steady employment and good wages. Address P. O. Box 686, Richmond, Va.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more pattern-makers, machinists and moulders.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—Competent, resourceful mechanics to learn adding-machine repair work. Steady employment in our branch houses after proper course of instruction at factory. Give experience. Box 634, AMERICAN MACHINIST.

Wanted—Good mechanical draftsman, one familiar with machine design, gasolene engines and air compressors preferred. State age, experience, references and salary expected. All communications confidential. Box 606, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	102
Acme Machinery Co.	34
Adams Co.	31
Albro-Clem Elevator Co.	82
Alliance Machine Co.	96
Almond Mfg. Co., T. R.	105
Alteneder & Son, Theo.	34
American Gas Furnace Co.	14
American Pulley Co.	101
American Tool Works Co.	8
American Tube & Stamping Co.	107
Armstrong Bros. Tool Co.	96 and 106
Auburn Ball Bearing Co.	89
Automatic Machine Co.	86
Backus Water Motor Co.	98
Baker Bros.	31
Baird Machinery Co.	83
Baldwin Chain & Mfg. Co.	106
Baldwin Steel Co.	79
Barnes Co., B. F.	97
Barnes Co., W. F. & John.	14
Barnett Co., G. & H.	4th cover
Bartlett, E. E.	92
Bay State Stamping Co.	88
Bay State Tap & Die Co.	87
Bay State Tool Co.	84
Beaman & Smith Co.	15 and 104
Becker-Brainard Milling Machine Co.	23
Bell Electric & Mfg. Co.	26
Bell Engineering Wks., David.	83
Bertram & Sons Co., John.	26
Besly & Co, Chas. H.	103
Bethlehem Fdry. & Mach. Co.	88
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	84
Bilgram, Hugo.	34
Billings & Spencer Co.	90
Binsse Mach. Co.	34
Birdsboro Steel Fdry. & Mach. Co.	71
Blaisdell Machinery Co.	106
Blanchard Machine Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	100
Boker & Co., Hermann.	77
Boston Gear Works.	92
Boynton & Plummer.	102
Bowers, E. J.	26
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	88
Bridgeport Safety Emery Co.	102
Bristol Co.	4th cover
Brown-Cochran Co.	98
Brown & Co., R. H.	104
Brown Hoisting Mach. Co.	97
Brown & Sharpe Manufacturing Co.	4th cover and 67
Brubaker & Bros., W. L.	89
Brush & Hudson.	81
Buffalo Forge Co.	4th cover & 80
Builders Iron Fdry.	3d cover
Bullard Machine Tool Co.	32
Bury Compressor Co.	106
Butler, A. G.	88
Calculagraph Co.	106
Caldwell & Son Co., H. W.	93
Carborundum Co.	24
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	84
Case Mfg. Co.	96
C & C Electric Co.	28
Chambersburg Eng. Co.	81
Champion Tool Works Co.	90
Chandler & Farquhar Co.	84
Chattanooga Machinery Co.	102
Chicago Rawhide Mfg. Co.	92
Chisholm & Moore Mfg. Co.	96
Cincinnati Electrical Tool Co.	86
Cincinnati Machine Tool Co.	25
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	110
Clark Cast Steel Cement Co.	108
Cleveland Automatic Mach. Co	18
Cleveland Crane & Car Co.	96
Cleveland Twist Drill Co.	4th cover
Cleveland Wire Spring Co.	86
Clough, R. M.	93
Coates Clipper Mfg. Co.	88
Coes Wrench Co.	33
Colburn Machine Tool Co.	24
Columbus Machine Co.	98
Cook Co., Asa S.	106
Crescent Forgings Co.	109
Cresson Co., Geo. V.	105
Crocker-Wheeler Co.	27
Crosby Steam Gage & Valve Mfg. Co.	17
Cumberland Steel Co.	108
Curtis, A. B.	93
Curtis & Co. Mfg. Co.	88
Curtis & Curtis Co.	86

PAGE

Cushman Chuck Co.....104
Davis, Rodney..... 92
Davis Machine Co., W. P..... 82
Detrick & Harvey Mfg. Co... 98
Diamond Machine Co....3d cover
Diehl Mfg. Co..... 26
Dill Machine Works, T. C. 26 and 82
Dixon Crucible Co., Joseph.. 85
Dodge & Day..... 89
Dreses Machine Tool Co..... 91
Druckleb, C.....106
Durbrow & Hearne Mfg. Co... 85
Dwight Slate Machine Co... 81

Earle Gear & Mach. Co..... 93
Eberhardt Bros. Mach. Co... 85
Eck Dynamo & Motor Works.. 26
Electro-Dynamic Co..... 87
Elliott Chemical Works..... 98
Elmira Machine Works..... 94
Equipoise Rivet Co..... 86
Errington, F. A.....105
Evans Friction Cone Co..... 94
Excelsior Needle Co.....106

Fairbanks Co..... 83
Farrel Fdry. & Mach. Co.....108
Fawcus Machine Co..... 92
Fellows Gear Shaper Co..... 92
Fenn-Sadler Machine Co.....105
Firth-Sterling Steel Co.....109
Fitchburg Machine Works.... 31
Foos Gas Engine Co..... 98
Fosdick Machine Tool Co..... 16
Franklin Mfg. Co. H. H.....100
Frevert Mach. Co..... 96

Gang Co., Wm. E..... 89
Gardner Engineering Co.....102
Gardner Machine Co.....102
General Electric Co..... 28
General Pneumatic Tool Co.. 97
Geometric Tool Co..... 25
Gleason Works.....4th cover
Goldschmidt Thermit Co....108
Goodell-Pratt Co..... 84
Gorton Machine Co., Geo..... 81
Gould & Eberhardt..... 90
Graham Mfg. Co..... 89
Grant Gear Works..... 92
Gray Co., G. A..... 34
Greaves, Klusman & Co..... 85
Greendale Gas Engine Co.... 98
Greenwald Co., I. & E..... 93

Hammacher, Schlemmer & Co. 73
Hampden Corundum Wheel Co..... 87
Harrington, Son & Co., Edw.. 95
Hendey Machine Co..... 75
Henley Publishing Co., N. W..81
Henry & Wright Mfg. Co..... 91
Heppenstall Forge & Knife Co.102
Hess-Bright Mfg. Co..... 91
Hill, Clarke & Co..... 83
Hisey-Wolf Machine Co.....101
Hoefer Mfg. Co..... 14
Horsburgh & Scott Co..4th cover

PAGE

Horton & Son Co., E.....104
Hunt Co., C. W..... 96
Hunt & Co., Robt. W..... 95
Hyatt Roller Bearing Co.... 85

Ingersoll Milling Machine Co. 89
Ingersoll-Rand Co.....107
International High-Speed Steel Co.....108
International Specialty Co..102
Iroquois Machine Co.....102

Jacobs Mfg. Co.....104
Jacobson Mach. Mfg. Co..... 98
Jantz & Leist Electric Co.... 26
Jeffrey Mfg. Co., The..... 82
Jenkins Brothers..... 85
Johnson Mach. Co., Carlyle... 90
Jones & Co., B. M.....108
Jones & Lamson Mach. Co. 12, 13 and 34

Kempsmith Mfg. Co..... 22
Kent & Co., Edwin R.....108
Keuffel & Esser Co..... 94
King Machine Tool Co..... 84

Landis Machine Co.....102
Landis Tool Co..... 69
Lapointe Machine Tool Co... 84
Le Blond Machine Tool Co., R. K.....4th cover
Le Count, Wm. G.....104
Link-Belt Engineering Co..... 80
Lodge & Shipley Machine Tool Co..... 4
Long & Allstatter Co., The...105
Lumen Bearing Co.....108
Lunkenheimer Co., The..... 85

Main Belting Co..... 87
Maris Brothers..... 96
Marshall & Huschart Mach. Co.....83 and 84
Massachusetts Saw Works.... 88
McCabe, J. J.....82 and 105
McGeorge Mfg. Co..... 84
Merrell Mfg. Co..... 88
Merrill Bros..... 89
Merritt & Co..... 81
Michigan College of Mines...104
Mietz, A..... 98
Miner & Peck Mfg. Co..... 89
Modern Machinery Daily News 89
Modern Tool Co..... 82
Moore & Co., Franklin..... 96
Morse Chain Co..... 89
Morse Twist Drill & Machine Co..... 33
Motch & Merryweather Machine Co..... 83
Mueller Machine Tool Co....105
Mumford Co., E. H..... 99
Mutual Machine Co..... 26

National Acme Mfg. Co.....110
National Brake & Clutch Co.. 79
National Separator & Mach. Co..... 81
New Britain Machine Co..... 95
New Era Gas Engine Co..... 98

PAGE

New Haven Mfg. Co..... 98
New Process Rawhide Co..... 93
New York Telephone Co..... 94
Newton Machine Tool Works.. 11
Nicholls, Wm. S..... 87
Nicholson File Co..... 17
Nicholson & Co., W. H..... 86
Niles-Bement-Pond Company, 82, 111, 112, 113, 114
Nolte Brass Co..... 88
Northern Electrical Mfg. Co.. 29
Northern Engineering Works. 96
Norton Emery Wheel Co..... 15
Norton Grinding Co..... 30
Nuttall Co., R. D..... 92
Nutter, Barnes & Co..... 81

Obermayer Co., S..... 95
O. K. Tool Holder Co..... 83
Olds Gas Power Co..... 98
Omega Steel & Tool Co.....108
Owen Machine Tool Co..... 22

Parker Co., Charles..... 89
Patterson, Gottfried & Hunter, Ltd.....103
Pawling & Harnischfeger..... 96
Paxson Co., J. W.....108
Philadelphia Bourse..... 85
Philadelphia Gear Works..... 92
Phillips-Lafitte Co..... 95
Phosphor Bronze Smelting Co. 88
Poole Co., J. Morton..... 26
Potter & Johnston Mach. Co.. 75
Pratt Chuck Co.....104
Pratt & Whitney Co.....2 and 3
Prentiss Tool & Supply Co... 82

Ransom Mfg. Co..... 1
Reed Mfg. Co..... 89
Reeves Pulley Co..... 24
Reichheim & Co., E. P..4th cover
Rich, J. & G..... 94
Rivett-Dock Company....3d cover
Rivett Lathe Mfg. Co....3d cover
Rockford Machine Tool Co...104
Rockwood Mfg. Co..... 95
Rogers Works, John M..... 87
Rowbottom Machine Co..... 86
Royersford Fdry. & Mach. Co. 94

Safety Emery Wheel Co.....102
Sames, C. M..... 96
Saunders Sons, D..... 85
Sawyer Gear Works..... 92
Schieren & Co., Chas. A..... 88
Schumacher & Boye..... 9
Schwerdte Stamp Co..... 88
Scranton & Co..... 87
Sebastian Lathe Co.....108
Sellers & Co., Wm..... 21
Seneca Falls Mfg. Co.....110
Shultz Belting Co..... 81
Sibley Machine Tool Co..... 89
Simonds Mfg. Co..... 82
Skinner Chuck Co.....104
Sloan & Chace Mfg. Co..... 34
Slocomb Co., J. T.....101
Smith & Mills..... 88
Soltmann, E. G..... 94

PAGE

Spacke Machine Co., F. W...106
Speed Changing Pulley Co.... 86
Spicer Universal Joint Mfg. Co..... 88
Sprague Electric Co..... 28
Springfield Machine Tool Co..100
Standard Connecting Rod Co. 99
Standard Engineering Works.. 94
Standard Gauge Steel Co..... 93
Standard Machinery Co..... 26
Standard Tool Co.....103
Stanley-G. I. Elec. Mfg. Co... 20
Stark Tool Co.....108
Starrett Co., L. S..... 16
Steptoe Shaper Co., John.....106
Stevens, F. B..... 95
Stoever Foundry & Mfg. Co.. 85
Straley & Hasbrouck..... 89
Struthers-Wells Co..... 98
Sturtevant Co., B. F..... 27
Switchboard Equipment Co... 27

Tate, Jones & Co..... 9
Taylor-Wilson Mfg. Co..... 92
Three Rivers Tool Co..... 84
Tindel-Morris Co..... 73
Triumph Electric Co..... 26
Trump Bros. Machine Co.....101
Turner Brass Works..... 94

Union Twist Drill Co..... 71
United Eng. & Fdry. Co.....109
U. S. Watch Tool Co..... 81

VanDorn & Dutton Co..... 92
Van Dyck Churchill Co...30 & 84
Vitrified Wheel Co.....102

Wallace Supply Co..... 85
Waltham Machine Works.... 98
Waltham Watch Tool Co..... 86
Ward & Sons, Edgar T., 33 and 108
Warner, C. S..... 98
Warner Instrument Co..... 87
Warner & Swasey Co..... 69
Waterbury Farrel Foundry & Machine Co..... 85
Watson-Stillman Co.....101
Webster & Perks Tool Co....103
West Haven Manufacturing Co.....4th cover
Westinghouse Elec. & Mfg. Co. 29
Westmacott Co., J. M.....104
Whitcomb-Blaisdell Machine Tool Co..... 19
Whitman & Barnes Mfg. Co.. 90
Whitney Mfg. Co..... 65
Whiton Mach. Co., D. E.....104
Wiley & Russell Mfg. Co..... 86
Wiley & Sons, John..... 34
Wilmarth & Morman Co..... 26
Windsor Machine Co..... 96
Wood's Sons, T. B..... 95
Woodward & Powell Planer Co. 88
Worcester Mach. Screw Co...106
Wormer Mach. Co., C. C..... 84
Wyman & Gordon Co...4th cover

Yale & Towne Mfg. Co..... 99

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
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Vitrified Wheel Co., Westfield, Mass.

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Ingersoll-Rand Co., New York.

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Ingersoll-Rand Co., New York.

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See Roller Bearings

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Cleveland Wire Spring Co., Cleveland, O.
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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
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Wallace Supply Co., Chicago, Ill.

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Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

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See Hoists Hand.

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Boynton & Plummer, Worcester, Mass.
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Northern Elec. Mfg. Co., Madison, Wis.
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Prentiss Tool & Supply Co., New York.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co Springfield, O.

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Sellers & Co., Inc., Wm., Philadelphia, Pa.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

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Cleveland Cap Screw Co., Cleveland, O.
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Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

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Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
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Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
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Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
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Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
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Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
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Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brazing Plates
Phillips-Laffitte Co., Phila., Pa.

Broker, Machinery
Warner, C. S., Niagara Falls, Ont.

Bulldozers
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Burners, Oil
Tate, Jones & Co., Pittsburg, Pa.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.
Nolte Brass Co., Springfield, Ohio
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Motor
Brush & Hudson, Brooklyn, N. Y.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.

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Warner & Swasey Co., Cleveland, Ohio.
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Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co. Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Double Friction Coil Clutch Co., Chicago, Ill.
Johnston Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., N. Y.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compounds, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compounds, Pipe Joint
Dixon Crucible Co., Jos., Jersey, City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

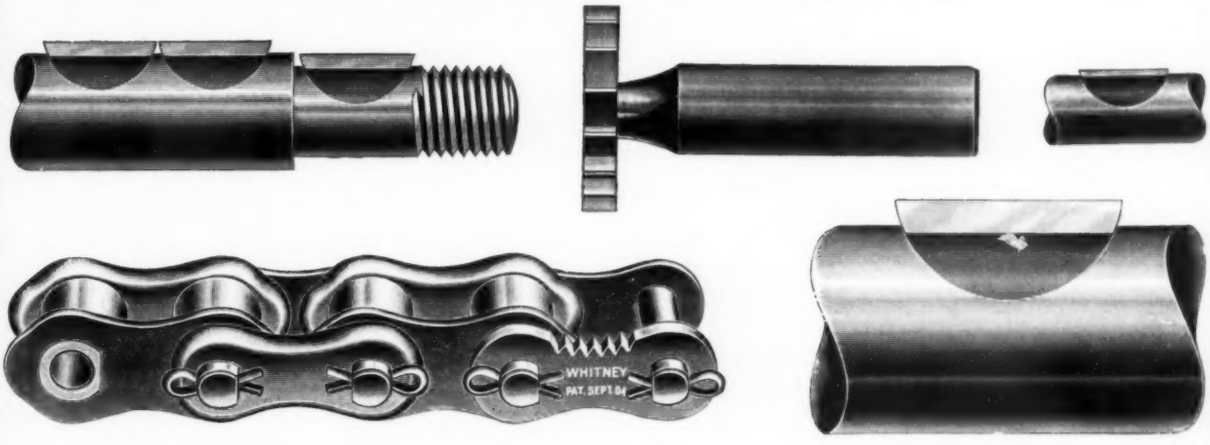
Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.



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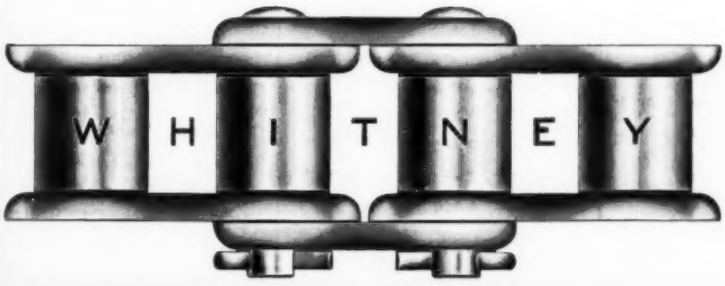

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WHITNEY MFG. CO.,

Hartford, Conn., U.S.A.

Cranes—*Continued.*

Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable

Nicholls, Wm. S., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

Cut Meters

Warner Instrument Co., Beloit, Wis.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Keuffel & Esser Co., New York.
Obermayer Co., S., Cincinnati, O.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials

Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.
Soltmann, E. G., New York.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co. Springfield, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn-Sadler Mach Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass
Hisey-Wolf Mach Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.

Drilling Machines, Radial *Continued.*

Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, Ohio.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M. Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Dynamotors

Sprague Elec. Co., New York.

Elapsed Time Machines

Calculagraph Co., New York.

Electrical Supplies

D'Olier & Co., H., Phila., Pa.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical

Dodge & Day, Philadelphia, Pa.
Thompson, Hugh L., Waterbury, Conn.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Philadelphia, Pa.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N.Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.